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# FEDERAL RESERVE'S UNCONVENTIONAL MONETARY POLICY AFTER THE FINANCIAL CRISIS

Master's thesis

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**ABSTRACT**

The financial crisis proved to be an extremely severe and long economical distress in the American economy. The crisis did not just entail a housing market crash but expanded into a nationwide recession that nearly caused a systemic crash of the whole US financial sector. During the midst of the crisis the US central bank, the Federal Reserve came to a conclusion that its conventional monetary tools were not sufficient to solve the problems within the economy and initiated a number of monetary easing programs that departed from the bank's conventional policy regime. Among other monetary actions, the new unconventional tools included many rounds of large-scale asset purchasing programs (quantitative easing) and zero bound interest rate policies. This study focuses directly into studying the effects of the Fed's quantitative easing and interest rate policies for the US economy after the financial crisis.

The purpose of this study is to examine the developments of the economical factors during 2009 and 2016 that the Fed has informed as its targets to influence through its monetary policy. In support of the empirical study, the paper goes through the background of the crisis and discusses the traditional policy regime of the US central bank. In the empirical part of the paper, the developments of the chosen economical factors are being compared against the Fed's asset purchasing data and the developments of the Fed's main directing interest rate. The statistical analysis is conducted using regression analysis and vector autoregressive modelling.

The results of the study confirm that the recovery has been slow in many of the target figures the Fed has wanted to influence. The unconventional monetary actions seem to have been more effective for adjusting different asset yields but it would appear that the Fed's failure to promote more expansive credit environment in the US might have caused the slow recovery in other economical sectors as well.

**KEYWORDS:** financial crisis, the Fed, quantitative easing, zero interest rate policy

# 1. Introduction

The beginning of the financial crisis in the US in 2008 marked a beginning of an era, where the whole American economy was facing a number of unprecedented challenges that impacted the entire nation's households, businesses, financial markets and policy makers. The deep recession was a product of a real estate boom that had been building up from the start of the millennium. However as the housing bubble burst the whole economy started recognizing that the soaring real estate market had created a systemic financial crisis that entailed an over levered household and financial sectors, where mortgage market related securitizing had made the whole economy over exposed for the real estate boom. The crash of the US financial sector drove the whole US economy into recession that spread on the interrelated financial markets all over the world.

The crisis struck not the least on the nation's central bank, the Federal Reserve (Fed). In the midst of the crisis the central bank realized that its conventional monetary tools were not sufficient enough to tackle the on going economical problems. This led to initiations of many different new unconventional monetary actions and tools in order to help the financial markets and the whole economy to recover. The new unprecedented monetary actions included for instance large-scale asset purchasing programs and commitments to very low levels of interest rate guidance. What made the period after the bursting of the financial crisis even more unusual for the Fed was the length of the particularly easy monetary policy regime. During the time after the crisis the central bank performed its large-scale asset purchases of different securities for many years and after lowering its main directing interest rate to zero, it was kept there for almost six years. After almost a decade of slow economic recovering the easy monetary policy is still very much in place. The large-scale asset purchases that have significantly increased the size of the Fed's balance sheet and the nation's monetary base have not yet been reversed and the main directing interest rate has only been increased by 0,5 per cent.

Because the monetary actions in the US after the financial crisis have been so unconventional and relatively large in historical perspective, it is important to study these policy actions to understand their nature and affects for the whole economy. For the future monetary policy regime, it is essential to comprehend why it has taken almost a decade for the policy actions to sufficiently start promoting economic recovery, or have they actually been nearly as effective as the central bank would have hoped. Additionally despite that the crisis started in the US, the recession quickly spread to other nations all around the world, and other central banks have since followed with the same type of

unconventional monetary actions to promote higher growth for their economies. The imitated monetary actions from the Fed have also been in place in other countries for many years, as have the ones in the US and therefore the same type of research for the policy regime's effectiveness is important. Moreover while the US economy has moved on a steadier growth path after almost a decade after the recession, it is essential to evaluate to unconventional policies for the future economical slowdowns to assess, whether it is justified to use these policies again should another recession hit the countries where these monetary policies have been used.

The large-scale asset purchasing programs have been studied many times after the crisis for instance by Chung (2011) and Krishnamurthy and Vissing-Jorgensen (2011). These researchers have studied how the financial markets and the economy have responded to the policy alterations on short-term and evaluated their effectiveness. However monetary policy action's tend to affect the economy in a lagged pace and the economical problems have certainly not only been short-term problems. This is why this paper studies the time of the US central bank's unconventional monetary policy as a whole from 2009 till 2016 to uncover how much merit can be granted for the monetary policy as a recovering force for the economy. The aim is to evaluate the Fed's monetary actions effectiveness in affecting the economical factors that the Fed has informed as its targets to influence. This can make it possible to evaluate the validation of the Fed's and other central banks' unconventional monetary policies and offer some insight on their usefulness for the future.

The study starts by discussing on the events that led to the bursting of the real estate bubble and the financial crisis in the late 2000's. By going through the background of the bubble, it is easier to understand the different challenges the Fed was facing during the crisis and why its conventional policy tools were not sufficient to solve the US economy's issues at the time. The following chapter discusses the Fed more closely as an institution and goes through the theoretical regime of its monetary policy. The chapter also goes through some previous recessions in the US, to provide contrast how the Fed has adjusted its monetary policy during those distressing times. The fourth chapter is dedicated for covering the events during the financial crisis and the Fed's new unconventional monetary tools that were initiated during those years. All this is followed by the empirical part of the study, which uses statistical analysis methods to study the relationship of the Fed's monetary actions and the development of chosen economical factors based on the Fed's informed targets it wanted to influence after the financial crisis.

# 2. The background of the crisis

The financial crisis will remain in the history as one of the most difficult economic recessions of our time. When the crisis started, the economic problems were unexpected and large in historical perspective, but included completely new systemic financial problems and economical risks. These new unprecedented economic issues forced the Federal Reserve to implement many new monetary policy actions in order to solve the acute financial distresses in the system and further help the economy to recover towards steady levels of growth. In order to understand thoroughly, why the Fed was forced to adjust its policy measures, it is important to examine the background of the crisis to understand the full range of the problems, which the central bank had to face during the financial crisis.

## 2.1. Early 2000's and consumption on debt

According to Bernanke (2012) the build up to the financial crisis started in the early 2000's after the technology stock bubble. Even though the stock market crash in 2000 drove the US economy into a recession, the slowdown was only a mild one and did not last long in a historical perspective. In spite of the relatively short economic slowdown, the Fed continued to practice easy monetary policy for many years, which it had started right away after the stock market crash in 2000. This easy monetary included low levels of the central bank's main directing interest rate, the federal funds rate (Fed Funds Rate). The Fed Funds Rate is the central bank's main tool, which it uses to control liquidity within its economy. It defines the interest rate, which private banks use when they loan assets for each other over night on their central banks' reserve accounts. From January 2001 all the way to early 2004, the Fed had dropped its Federal funds rate from above six per cent to under two per cent where it stayed for over two years. Bernanke (2012) states that in addition to the fears the Fed had about weakening consumer confidence after the 9/11 terrorist attacks, the central bank wanted to keep the Fed Funds Rate low to support the labour market in the early 2000's. While the central bank was still lowering its directing interest rate, economic growth and inflation started to accelerate (Goodhart 2008).

Accelerating economic growth and low levels of interest rates started to create the first building blocks for the financial crisis of 2008. Because the inflation rate started grow-

ing, reaching already two per cent in late 2003, the real interest rates in the economy dropped lower and lower. When consumers consider their financial decisions they take into account the levels of inflation and real interest rates. When inflation accelerates and nominal interest rates stay low, real interest rates keep decreasing, which encourages households to consume more instead of saving more out of their income, and take on more credit. (Goodhart 2008.) While households in America were starting to demand more and more credit on low interest rates, the banking sector was willing to increase their supply of credit for this demand, because they were able to loan out affordable new funds from their central bank's reserve accounts on low Fed Funds Rate. (Ala-Nissilä 2010: 15–16.)

While the expanding levels of credit and consumption might have been encouraging signs for the economy, the problem was that the banking sector started increasing their levels of risk in their lending actions. This increasing risk taking was seen especially in the banks' mortgage lending. (Ala-Nissilä 2010: 15–16.) In the early years of the 21st century, the banks in the US started decreasing their standards for viable mortgage candidates. Before the early 2000's, it was common that a new applicant for a mortgage had to be able to provide a down payment of 10–20 per cent of the house's sales price to be eligible for the loan. Additionally the banks investigated the applicant's income levels, net worth of their assets and information about their credit history. But as the demand for mortgage loans accelerated and the interest rates stayed low, the banks started lowering their down payment demands and reducing background checks for the applicants. This meant that home ownership became possible for a larger portion of the nation, which accelerated the growth of mortgage lending even more. (Bernanke 2012.)

While homeownership became more and more common, the house prices in America started rising rapidly and households started increasing their consumption. As less solvent people became homeowners, households started consuming on credit. (The Financial Crisis Inquiry Report hw. FCIR 2011: 83–84.) According to Bernanke (2012) the increasing consumption was driven by the optimism of the soaring house prices. In fact, the house prices had risen by ten per cent per year between 2000 and 2004 and moreover around 15 per cent per year in 2005 and 2006 (Hellwig 2009: 156.) The strong sentiment in the housing markets created a false picture in the consumers' minds about their levels of wealth. Bernanke (2012) describes how the prevalent sentiment during those years was that consumers did not put much weight on their income levels as long as the price of their houses kept going up. This sentiment empowered households to even greater amounts of credit-supported consumption. The Figure 2 illustrates how rapidly the housing market grew in the early 2000's before collapsing.

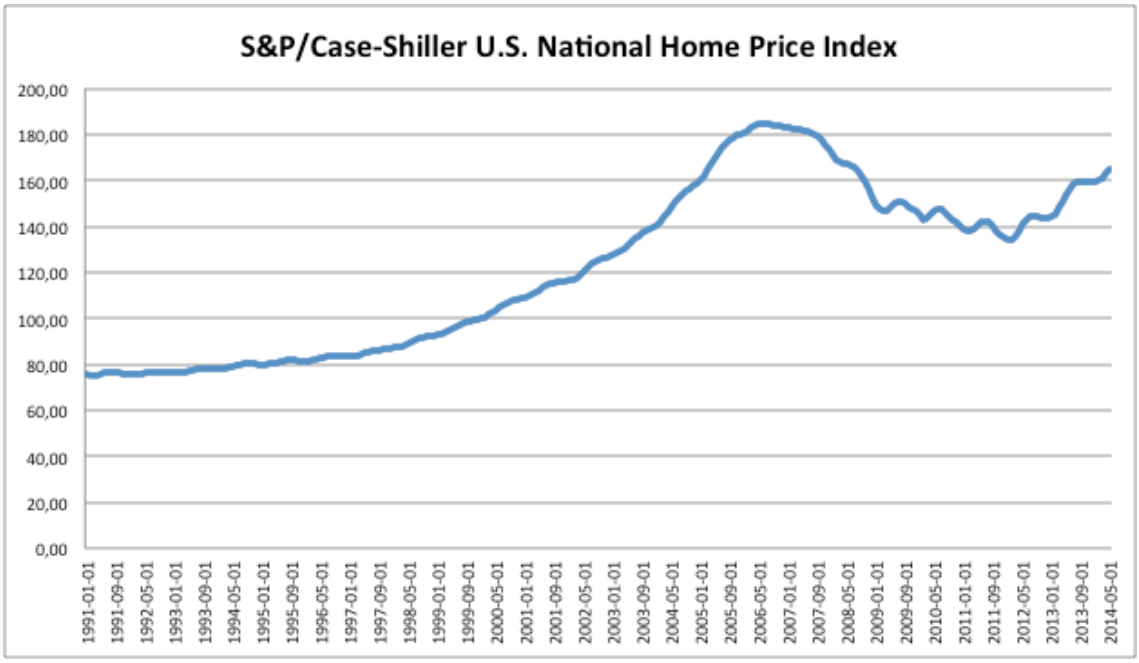


**Figure 1.** S&P/Casa-Shiller U.S. National Home Price Index 1991–2014

As the house prices kept rising, cash out refinancing became very popular among the new homeowners (FCIR 2011: 34). This meant that households did not only spend a larger portion of their income on consumption, but wanted to concretely take advantage of their risen house prices, by taking out new loans against their house (Bernanke 2012). In cash out refinancing, the borrower is offered the possibility to take out a new loan on their existing mortgage. For instance, if a household has 80 000 dollars left to pay on their mortgage and their house's market price is 200 000 dollars, their house's equity is equal to 120 000 dollars. In this situation the household can utilize refinancing and take out a new loan against their house's equity. If the loan amount exceeds 80 000 dollars, the household can take out this extra amount of capital as cash for consumption. (The Federal Reserve Board 2008.)

While the house prices kept soaring, refinancing seemed like a safe and rational way for households to increase their purchasing power (Bernanke 2012). The popularity of refinancing loans grew substantially. In 2000 American households took out refinancing loans for 460 billion dollars, but by the end of 2003, the total worth of refinancing grew to 2,8 trillion dollars. (FCIR 2011: 34.) People utilized their new excess purchasing power and bought new cars, luxury items and renovated their homes. Bernanke (2012) points out that in addition to this dangerous phenomenon of excessive consumption through debt, people also started to use their refinancing cash as collateral for new loans. While the housing market seemed steady and profitable, people also used their

refinancing cash as down payments for new homes they bought as investments. This accelerated the demand for homes even more and allowed the housing market bubble to grow even larger. By the spring of 2004 69,2 per cent of US citizens were homeowners. In 2005 ten per cent of all house acquisitions were made by financial institutions or by people buying their second home. 2006 marked the peak for the mortgage markets, as Americans borrowed 334 billion dollars in mortgage loans, seven times more than in 1996. (FCIR 2011: 34.)

While Americans were increasing their consumption, their real incomes did not follow with the same pace (FCIR 2011: 34). Figure 2 illustrates the development of US households' consumption and real income. From figure 2 it can be seen that while the income levels decreased during 2000 and 2003, Americans still increased their consumption during the early 2000's. As the consumption increase was at its peak at above six per cent in 2004 and 2005, American households still only earned as much or one per cent more as they did in the previous year. This strengthens the fact how the increasing consumption had to be filled by credit, since households' income levels were not sufficient to sustain their consumption expenditures.

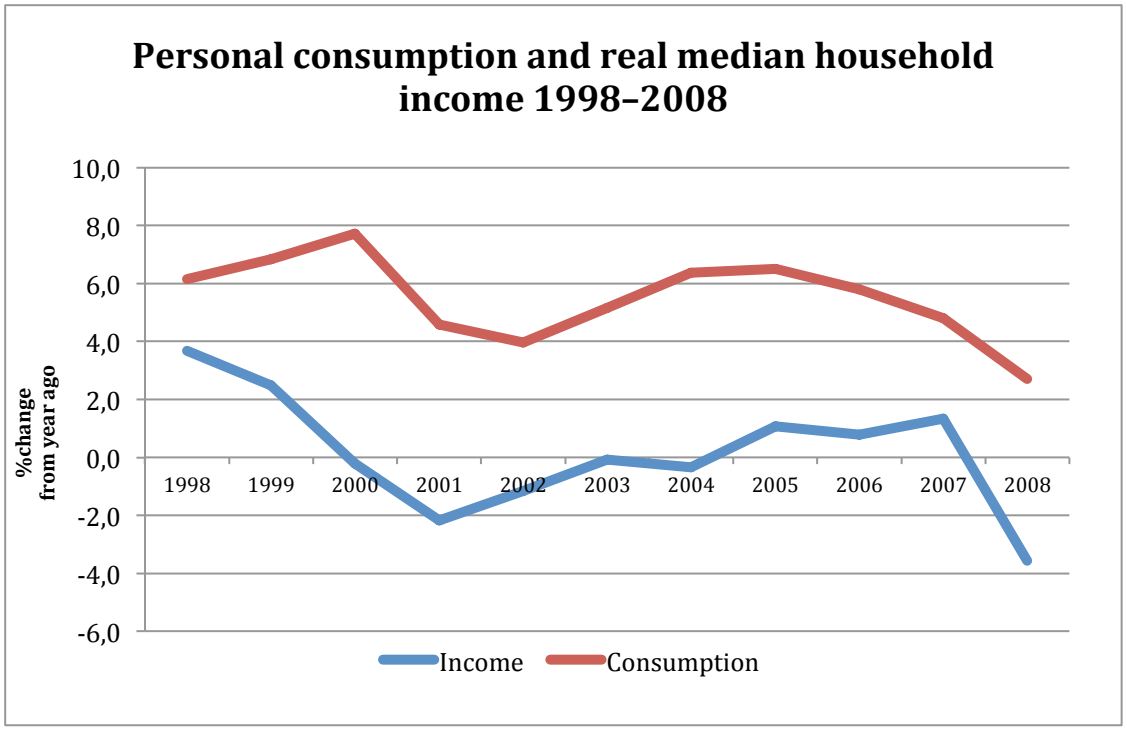


**Figure 2.** US households personal consumption and real median income

## 2.2. Financial markets

As the housing markets in the US kept booming and households continued to exploit the souring house prices by increasing their levels of debt and consumption, entities in the financial sector started to utilize the developments within the economy as well. Low interest rates and the accelerating growth in the mortgage market started to generate more leveraging in the banking sector and new mortgage related securities were introduced to the markets.

As mentioned in the previous chapter, mortgage lenders started to ease their requirements for mortgage lending in the early 2000's. Because home owning became more and more popular the market for standard mortgage loans was saturating. But since the housing market kept going up, increasing mortgage lending was still in the banking sector's interest. As a solution for the saturating mortgage market, the banking sector started to increase their mortgage lending by offering home loans for a broader population. This happened through a rise in so-called sub prime lending. Sub prime mortgages were loans where the banks did not require as high standards from the mortgage applicant as they did with their standard home loans. For instance the applicants' capital and credit score requirements were lower and the payment plans were not as strict as they were in regular mortgage lending. Sub prime lending became a popular business in the American banking sector and the banks increased their risks and exposure in the housing markets. (Bernanke 2012.)

Hellwig (2009) explains, that the soaring housing markets were the biggest incentive for the banking sector to increase their levels of risk through sub prime lending. Traditionally mortgage lending is a stable and a low-risk business for the banking sector. Conventionally the banks thoroughly check the mortgage applicant's backgrounds and financials during the application process and the house usually serves as a guarantee for the debt. As the borrower pays back the debt, he also pays interest, which is the banks' profit from the loan. Mortgage interest payments are traditionally low risk cash flows for a bank, which it uses to finance its other financial operations. If the house owner were to default on his mortgage, the house would become property of the bank. (Federal Trade Commission 2016.) When the banks increased their levels of risks through sub prime lending, it became more probable that more loans in their mortgage portfolios would convert into houses on the banks' balance sheets in case of increasing defaults. But as the market prices were soaring continuously, the banks were confident that they

could simply sell the houses they had to repossess through possible mortgage defaults and make a profit from the soared market price. (Bernanke 2012.)

The possibility to offset the risk derived from sub prime lending by souring house markets, increased sub prime lending significantly in the beginning of the 21st century. Since 2000, the portion of sub prime loans grew form nine per cent to 40 per cent out of all mortgage loans. (Hellwig 2009.) Bernanke (2012) also points out that as the sub prime market grew larger, the minimum requirements for receiving a sub prime loan decreased. For instance between 2001 and 2006 the portion of the sub primes where the required down payment was less than ten per cent of the house's market value grew from five to 14 per cent. Loans where banks mandated few or no background checks at all increased from seven per cent to 18 per cent out of all loans. On average sub prime loans required a six per cent down payment and half of the sub prime applicants enjoyed lower standards of background checking. (International Monetary Fund 2007.)

Hellwig (2009) describes how the increased profits derived from sub prime lending operations started to raise the interest of investment bankers and other investors. Since the interest rate levels were still low during the early 2000's due to the Federal Reserves' monetary easing, investors were seeking earning opportunities elsewhere than from the bond markets. This was creating an increasing demand for alternative securities and the mortgage lenders saw an opportunity to satisfy this demand. The mortgage lenders who had been increasing their conventional and sub prime lending started to bundle their separate mortgages together and securitizing them.

Securitization of mortgage loans by the banks meant that they started creating new financial products based on the cash flows derived form the loans. This way they were able to lower their total exposure to the housing market and turn their risky sub prime loan portfolios to cash by selling them forward for other investors. (Hellwig 2009.) These securitized products made out of mortgage loans are called mortgage-backed-securities (MBS). A creation of an MBS-product meant that the mortgage brokers gathered loans out of their mortgage portfolios together into a security, where the cash flows for the investor came from the original house owners interest and loan payments on the mortgage. The house behind the mortgage served as the guarantee for the security, hence the title mortgage-backed-security. (Securitites and Exchange Commission 2014a.) These products became popular among investment bankers in the early 2000's. They bought them both as investments for them selves and brokered them forward to other entities as well.

According to Pickert (2008), a large portion of the MBS selling were done by the two largest mortgage brokers in America, Fannie Mae and Freddie Mac. Originally these companies were government-established entities, whose purpose was to support the domestic real estate market and to enable home owning for families in the US. They did this by purchasing mortgage loans from private banks to release new capital, which the banks could lend forward to new home loan applicants. Fannie Mae was privatized in 1968 and Freddie Mac in 1989, because the debt burden of these two companies had grown too large for the government to maintain.

Fannie Mae and Freddie Mac were active entities in the creation of the MBS-markets already before the 21st century. Traditionally the mortgages they bought had to meet high standards and the solvency level of the household behind the mortgage had to satisfy tight criteria. After buying the mortgages Fannie and Freddie guaranteed the loans them selves and sold them forward for investors as MBSs. These MBSs were treated as very safe investments, because the markets saw Fannie and Freddie as stable and solvent companies due to their government background, even though they had been privatized decades before the creation of the MBS-market. (Hellwig 2009.)

The turn of the century brought changes to Fannie Mae's and Freddy Mac's business models, when George W. Bush's government started promoting home ownership for a larger part of the economy. The government started pressuring Fannie and Freddie into buying sub prime loans as well as traditional high-class loans in order to add pressure for the private mortgage brokers to provide more sub prime loans as well. (Hellwig 2009; Overdose 2012.) The sub prime loans Fannie and Freddie bought in the early 2000's were bundled together as MBSs' and sold for investors. Hellwig (2009) describes that investors had a very high interest for the MBSs created by these two entities, because the investors still considered Fannie and Freddie as government related agencies with a small chance for solvency issues.

Now investment banks were buying MBSs form separate private banks as well as form Fannie Mae and Freddie Mac. As the MBS portfolios grew larger, investment banks developed the mortgage-related financial market further by creating new securities from the MBSs called collateralized debt obligations (CDOs). Typically a CDO was built by gathering hundreds of MBSs together into a one security, which was divided into separate tranches. The tranches were classified by their level of risk, defined by the credit ratings of the mortgages that belonged into the tranche. The riskier a tranche was, the higher was the expected return from that tranche for the investor. By gathering lots of mortgages with different credit ratings into the CDO, they were able to lower the riski-

ness of the whole security. As the CDOs were diversified with portions of different credit rated mortgages, the banks were able to mitigate the risk that all the mortgages in the CDO would go into default and turn the security's value to zero. (FCIR 2011.) The CDO's diversified risk characterization made them a popular and profitable product for the investment banks to sell.

In addition to the creation of the CDOs, a product called a credit default swap (CDS) became popular in the US financial markets. CDSs were financial derivatives that worked as insurance products for investors that generated cash flows if the underlying asset of the CDS failed. CDSs became popular products for CDO-investors, who wanted to hedge them selves against possible defaults in the CDO's underlying mortgages. While the sentiment remained strong in the US real estate market, insurance companies and investment banks were willing to sell large amounts of CDS insurances for investors. As long as the underlying assets did not go into default, the sellers of the CDSs collected transaction fees and premiums from the CDS trades generating growing cash flows while the housing market was still on the rise. (Securities and Exchange Commission 2014b.) Ala-Nissilä (2010: 17) emphasizes that the CDS markets entailed some dangerous developments within them in contrast to the traditional CDS framework. The traditional model was that the person buying a CDS owned the underlying asset as well. As the markets moved closer to the beginning of the financial crisis of 2008, the CDS markets had become more complex, because investors were buying CDSs for speculating purposes for underlying assets they did not even own them selves. Ala-Nissilä (2010) describes this scenario similar to a person buying an insurance on their relative's or their friend's house.

While house prices rose by 27 per cent between 2003 and 2007, the banks created and sold four trillion dollars worth in MBSs and 700 billion dollars more in CDOs derived from those MBSs (FCIR 2011). CDOs appeared as safe investments in the eyes of the public and the possibility to hedge against default risks through CDSs supported the demand for CDO's even further. Hellwig (2009) describes how the false sense of safety about the housing markets and about the products derived from them was one of the major reasons behind the real estate bubble. On top of the prevalent optimism and incoming profits, the US rating agencies have been criticized for their poor standards in their rating of MBSs and CDOs, which according to Goodhart (2008) and Hellwig (2009) has likely played a major role in the build up for the financial crisis.

## 2.3. The crisis begins

The beginning of 2006 marked the turning point for the US economy, when first signs of vulnerabilities within the system started revealing themselves. All of the developments discussed in the previous chapters, such as overconsumption, high amounts of debt and complexity of the financial markets had formed a chain of events that were heading towards overheating within the economy.

According to FCIR (2011), the first signs of overheating were seen in the housing markets. In the spring of 2006 the number of homes sold per month started decreasing and the average time it took to sell a new home reached its highest level during the on going decade. Bernanke (2012) states that the market prices of the real estate market had simply grown too high at that point for the average household. And as the Federal Reserve had started tightening its interest rate policies, the combination of high market prices and relatively high interest rates prevented the housing boom to continue any further.

In addition to the demising demand, the house prices started declining due to the increased supply on the markets. The increased supply of new houses derived from the rising default rates on mortgage loans. In 2006 more and more households started having troubles on making payments on their mortgages. Especially these troubles started to occur in the sub prime portion of the house loans. (Mayer, Pence & Sherlund 2009.) Rising mortgage defaults meant that the underlying houses of these loans were becoming property of the banks that had originated the loans. (Overdose 2012.) In a conventional situation, the portion of mortgage defaults for a bank is very small and the bank usually can off set its losses from the default by selling the property on the markets. Now the situation was different, because mortgage default rates started accelerating rapidly. (FCIR 2011: 215.)

Firstly the rising default rates meant that banks were no longer receiving cash flows from the mortgages. Another problem was that now more and more mortgages were turning into empty houses on the markets owned by banks or other investors. This meant that supply of empty homes increased substantially on the markets while the demand for new homes was decreasing at the same time. This eventually led into a price crash in the housing markets in 2006. As the house prices declined the banks who now had become owners of the defaulted mortgage homes could not sell them at a price that would have been even close to the value of the original mortgage. On the other hand even if the banks were willing to sell the properties at a loss, the demand for houses was

weakening, which made this option difficult as well. (FCIR 2011: 215–17.) Figure three illustrates the connection between rising mortgage delinquencies and home price development. Figure three shows how the blue curve illustrating the national home price index reaches its peak in 2006 just before the red curve of mortgage delinquencies hikes significantly.

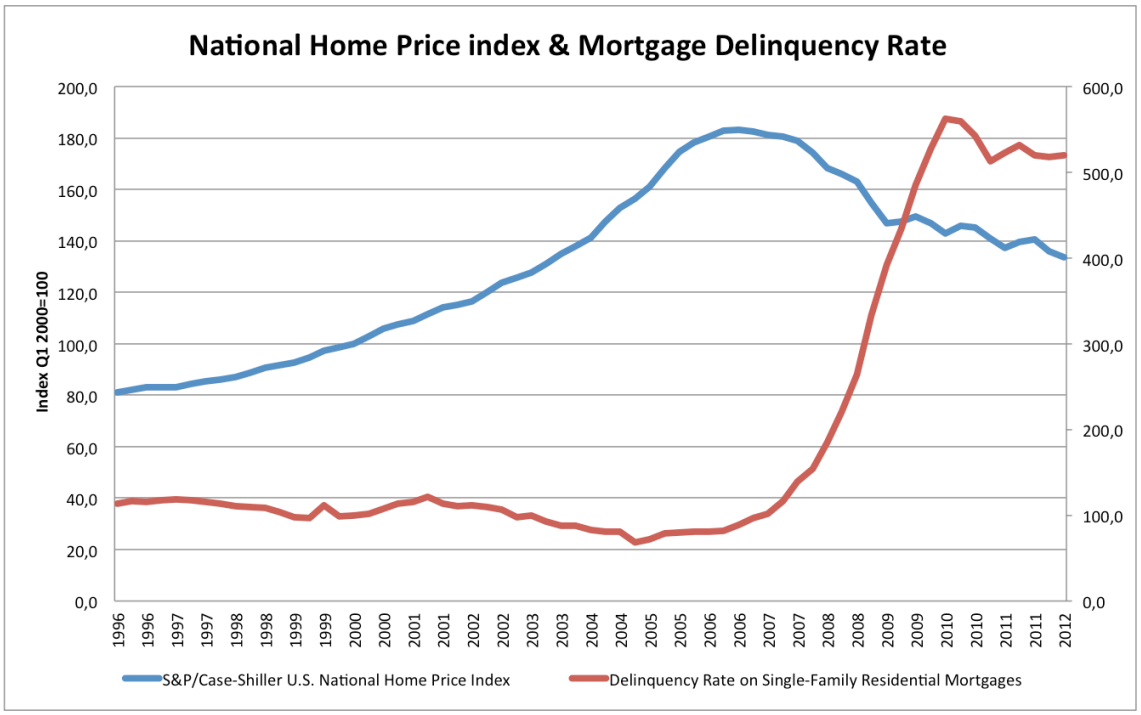


**Figure 3.** Development of house prices and mortgage delinquencies in the US

Rising delinquency rates and the price crash in the housing markets started causing liquidity problems for the US banking sector during 2007 (Bernanke 2012). Mishkin (2010) describes this development as the "first phase" of the financial crisis that occurred at the end of the decade. As mortgages converted into houses and house prices crashed, the financial products derived from them failed as well. The MBSs and CDOs that relied on the cash flows from mortgage and interest payments did not generate any profit anymore and their values dropped significantly on the markets. The CDS-insurance products were another liquidity problem for the entities that had sold them as well. The CDS sellers simply had not prepared them selves with enough liquidity for a market wide crash in the CDO market, and their assets were not sufficient for making payments for all of the investors who had bought CDSs from them. (Bernanke 2012.) In many cases banks were simultaneously owners of CDOs and sellers of CDS derivatives for those CDOs as well. These developments caused liquidity problems for the whole US banking sector. The banks could not use valueless MBS securities as guarantees for new loans anymore or sell them for other entities either. Trust between financial entities

started deteriorating significantly. This was a serious problem because in order to keep their short-term liquidity sufficient, banks need to be able to loan short-term assets from one another. Now the whole banking sector was struggling with mortgage related securities and the complexity of the security market raised the levels of uncertainty, which eventually led to a "credit crunch" within the financial sector. (Mishkin 2010; Mizen 2008.)

By the beginning of 2008 losses in sub prime related financial products were estimated around 500 billion dollars (Mishkin 2010). The lack of trust and liquidity within the financial sector started generating dangerous phenomena. The first concrete following of the credit crunch was seen in March 2008, when Bear Stearns, one of the largest investment banks in the country failed. Bear Stearns was the first big bank in the US, whose liquidity problems grew so large, that it could not operate on a daily basis anymore. The lack of trust in the financial sector meant that no other entity was willing to by its short –or long-term assets, which Bear Stearns would have needed in order to manage its daily operations. (Mizen 2008.)

By this stage the Federal Reserve decided to intervene in order to prevent further unwanted developments in the financial sector, and brokered the selling of Bear Stearns to another investment bank, JP Morgan/Chase. This action by the central bank relieved the on going panic within the financial sector and restored trust in the markets. During the spring of 2008 interbank interest rates decreased back to their average levels before the problems of Bear Stearns and the worst credit crunch was relieved from the markets. (Bernanke 2012.) Mishkin (2010) describes how the prevalent sentiment by the summer of 2008 was optimistic and markets saw that the worst was already behind. The financial crisis would however burst on its full scale later on in 2008, when the fourth largest investment bank in the country, Lehman Brothers went into bankruptcy on September 15. Mishkin (2010) describes the bankruptcy of Lehman Brother as the beginning of the "second phase" of the financial crisis.

"The second phase" of the financial crisis described by Mishkin (2010) begun when Lehman Brothers filed for bankruptcy due to its too large debt burden and delinquency problems. Lehman was unable to settle its debt positions with any other American bank, and no other bank in or outside of the US was willing to acquire Lehman to solve the issue as had happened earlier in the year with Bear Stearns. The Federal Reserve tried to reach a settlement with other US banks during the weekend before Lehman's bankruptcy, but no entity was willing to take Lehman's debt burden on their own balance sheet. In Lehman's case the Federal Reserve was not willing to intervene with the markets

either as it had in the case of Bear Sterns where the Fed had taken some of Bear's debt burden under its own balance sheet in order to get JP Morgan/Chase to buy the bank. (FCIR 2011.) The Fed was not willing to take on more bad securities and loans on its balance sheet and according to Mishkin (2010), it wanted to make a statement for other large banks as well that the central bank was not going to reward entities for excessive risk taking and bail every struggling bank out. Failed negotiations for structuring a bail out solution led to Lehman Brothers filing for bankruptcy on September 15 2008.

Effects of Lehman's bankruptcy were instant on the financial markets. Bernanke (2012) states that the world's largest insurance company AIG was the first and largest sufferer of Lehman's bankruptcy. AIG had participated heavily in the CDS markets and had sold CDSs for more than 400 billion dollars. When Lehman filed for bankruptcy AIG started having instant liquidity problems when investors were demanding money from Lehman's failed securities for which they owned CDSs against. The shock of Lehman's bankruptcy was too high for AIG's short-term liquidity and AIG would have needed significant aid from other market operators in order to withstand its current situation. Trust for AIG's health was too weak in the markets and the insurance company was not able to gather enough funding to withstand its liquidity problems. On September 16$^{th}$, just a day after Lehman's bankruptcy, the Fed granted an 85 billion dollar loan for AIG, in order to avoid its complete failing. (FCIR 2011.)

Lehman's bankruptcy and AIG's problems drove the whole US financial system into a state of panic. The bankruptcy of the nation's fourth largest investment bank and the problems of the world's largest insurance company proved, that no financial entity was too big to fail anymore. Every bank on Wall Street had participated in the same mortgage related market that had bankrupted Lehman, and no one knew who had taken largest amounts of risk and was next in line to fail. This uncertainty caused a state of complete lack of trust between the financial entities and availability of liquidity froze up again even more than it had earlier in that same year. The values of MBS and CDO securities, that had driven Lehman into bankruptcy, collapsed since every entity in the market was trying to get rid of them at the same time. Availability of credit was gone, because mortgage related securities were not eligible as guarantees for new loans anymore. The lack of trust between banks reflected to private lending as well, as lending for households and private corporations froze up too. The recession that had started from the declining housing markets in 2006 had now escalated into a nation wide financial crisis. (Mishkin 2010.)

## 2.4. Comparisons to other economic crises

After the collapse of mortgage-related securities market the whole US economy drifted into a financial crisis, to which the government and the central bank had to respond aggressively. The actions the Federal Reserve took were sizable on a historical perspective and partly completely unseen before. In order to understand the reasons behind the monetary actions taken by the Fed, it is suitable to compare to characteristics of this crisis into other times in history, where different economical recessions have occurred in different economies.

A rapid rise in some asset class valuation and optimism derived from it, such as the housing market in the financial crisis, have been a common characteristic in the history as well that has preceded a recession. During the technology bubble in the turn of the 21st century the prevailing sentiment was extremely optimistic about the rise of the technology sector in the US, which led to a rapid rise and fall of the stock market. The stock market crash eventually caused a short recession in the US economy. Price bubbles caused by over optimism have been seen also in the Netherlands during the so called "Tulip mania" and during the great depression in the US in the 1930's, when corporate stock ownership became more common among the public. (Trueman 2014.) In the financial crisis the overheated asset class was real estate, which relates directly to household consumption and consumer confidence. Public infrastructure such as education, security and healthcare are based on habitation, which means a crash in real estate has direct and large multiplying effects on a whole economy level. (FCIC 2011.) Another unique characteristic of the financial crisis was the linkage between the securities market and the real estate market. In the financial crisis there was not just a crash in single asset class, but a systemic slowdown occurred due to the financial sector's high exposure for the real estate market.

Another typical characteristic behind a recession is an unendurable rise in levels of debt, which occurred also in the early 2000's before the financial crisis. High levels of debt were a problem as well in the 1920's in the US before the great depression. Back then the technological development of agriculture was forcing entrepreneurs to invest in new equipment to keep up with the competition. This compelled them to take on large amounts of debt to cover the new investments. Eventually when the value of owned land decreased in the great depression many farmers were caught in a debt trap and unemployment rose significantly. (Mishkin 2000: 231; Trueman 2014.) What was problematic in the financial crisis was that the risen levels of debt were associated with the

housing market, which only generated overconsumption, speculation and risks. In the 1920's part of the debt problem related to investments in agriculture, which promoted attempts to increase productivity, not just speculation as was the case with the housing bubble.

Long periods of cheap money due to low levels of interest rates associates itself with many recessions in the past as well as it did in the early 2000's. This has been seen in the past for instance in Japan and in Finland. As the banks increased their lending operations in the US in the early 2000's, banks in Japan acted in a similar fashion in the 1980s when they started increasing their lending for real estate and construction sectors. The expansion in credit supply was derived from low interest rate environment in Japan as well and was associated with rising real estate values too. (Vanhala 2009.) In Finland the international money markets were liberalised in the 1980s, which enabled Finnish banks to expand their foreign credit operations. During those years the interest rate environment was lower in Germany than it was in Finland, which encouraged Finnish banks to loan out interbank funding from Germany and lend that money forward for Finnish households. This caused an expansion of credit levels among Finnish consumers, which caused a hike in the price levels of the Finnish real estate market. Eventually when the interest rate levels rose in Japan and in Finland, the grown asset price bubbles burst and both economies fell into recessions. (Kiander 2001: 15–16.) While the real estate bubble burst was similar in the US to what happened in Japan and in Finland, the American financial sector had become highly exposed for the real estate market and the complexity of the financial products and the systemic risk they had caused eventually caused more complex issues for policy makers to solve.

# 3. The Federal Reserve

Before examining the Federal Reserve's actions and policy responses to the financial crisis, it is suitable to take a closer look into the Fed's traditional role as a monetary policy governing entity. To build a comprehensive understanding of the Fed's operations, this chapter takes a brief look into the central bank's history and its original purpose, structure and basic monetary tools. Therefore it is easier to understand what changed in the Fed's monetary policy after the financial crisis and what were the reasons behind the new policy tools.

## 3.1. Founding of the Federal Reserve and its structure

Mishkin (2000: 181–182) states that before the 20th century there was still significant amounts of resistance among policymakers against centralized conduct of monetary policy. Having one central bank for the whole nation was a negative thought among the general public as well. According to Mishkin (2000) the public was afraid that a central bank would be too vulnerable to the influence of the nation's large banking institutions, and did not feel there was a need for a banks' bank that could intervene to the functionality of the free markets. This prevalent sentiment was changing however in the turn of the 19th and the 20th century, when times of economical slowdown were causing more and more bank runs. These bank runs, where people rushed to withdraw their cash from their accounts, were causing serious liquidity issues for the nation's banks and the financial system's health was deteriorating. The problems caused by the bank runs eventually convinced the politicians and the public that there was a need for an entity, that could provide additional liquidity during recessions and serve as the lender of last resort. To serve this need, the Federal Reserve System was founded by the US congress in 1913. (Mishkin 2000: 181–182.)

The Federal Reserve System was founded to maintain a flexible currency, to serve as a bank supervisor and to act as a liquidity provider for the US economy (The Federal Reserve Board 2013: 15). The Federal Reserve System was defined to consist of 12 regional central banks, an open market committee and a governing council, The Federal Reserve Board. The 12 regional banks were made responsible of bank supervision and issuance of currency. The regional central banks act also as the bank for the US treasury. (The Federal Reserve Board 2013: 3–6.) The ownership of the regional central

banks is partially divided between governmental authority and the private sector. The private banks that are part owners of their regional central banks belong to the Federal Reserve System as well. Nowadays the three largest regional central banks by assets are Chicago's, San Francisco's and New York's Federal Reserves, whose assets stand for over 50 per cent of the whole Federal Reserve System. The most important of these three is the New York Fed, whose assets cover around 25 per cent over the whole system. New York Fed's chairman is the only chairman who has a permanent seat at the open market committee. (Mishkin 2000: 184.)

Federal Reserve's Board of Governors is responsible for the supervision of the regional banks. The Board of Governors consists of seven board members. Aside from supervision, the Board also defines the reserve requirements for all commercial banks and accounts for the interest rate of the Fed's discount lending. The chairman, which the Board of Governors select is a very influential political figure in the US and also serves as an advisor for the nation's president. One term for the chairman lasts for four years. The Board of Governors has a very active role in the US monetary policy and all of the seven members also serve in the Fed's open market committee. Five other members in the committee are the New York Fed chairman and four other regional Federal Reserve chairmen. The open market committee decides on the most important aspect of the Fed's monetary policy, the supply of money. The committee affects the supply of money by purchasing and selling long term securities, adjusting its reserve requirements and altering its discount lending interest rate. (Mishkin 2000: 183–189; The Federal Reserve Board 2013.)

### 3.2. The Federal Reserve's traditional monetary policy

Currently the Fed's three main goals it tries to reach through its monetary policy are maintaining steady price levels, maximum employment and reasonable levels of long-term interest rates. To reach these goals, the Fed uses three main monetary policy tools. The most important monetary tool are banks' reserve requirements, discount lending and open market operations. By using these tools the Fed aims to achieve the most efficient results in accordance to its monetary goals and to smoothen out economical cycles. (Board of Governors 2016; Mishkin 2000.)

The Fed's reserve requirements are a direct linkage between the Federal Reserve System and the financial sector. These requirements command the amounts of assets that

private banks are required to hold on their reserve accounts at their local Federal Reserve Bank. These reserves are an important source of short-term liquidity for private banks, which they lend out for each other between their reserve accounts. The interest rate used for these transactions is the Federal Funds Rate (Fed Funds Rate). The Fed Funds Rate, which the open market committee is responsible of, is a significant factor for the availability of extra liquidity for the financial sector. Therefore adjustments to the Fed Funds Rate directly affects to the liquidity levels in the financial sector, which then affects the short –and long terms market interest rates, value of the dollar and the stock markets. This chain reaction is a very significant factor in the central banks' operations, and therefore changes and future expectations of the Fed Funds Rate are an important driver for the financial markets and the whole economy. (The Federal Reserve Board 2013.)

When the Fed decides on its main directing interest rate, the Fed Funds Rate, it does not actually set out a certain fixed rate for it. The Fed actually reports a target range where it wants the interest rate to fluctuate within and it has to make adjustments to its policy tools in order to get the Fed Funds Rate within the boundaries it wants it to be. As said before, the Fed Funds Rate serves as the interest rate for transactions between private banks on their reserve accounts. Therefore when the Fed wants to alter its main directing interest rate, it can affect it by making adjustments to its reserve requirements for private banks. The reserve requirements represent a certain percentage of a private bank's assets that it is required to deposit on its reserve account at its local Federal Reserve. Therefore when the Fed changes these reserve requirements, it affects the demand and supply of cash on the reserve accounts markets between private banks. (Mishkin 2000: 209–210.)

For instance, if the Fed aims to decrease private banks' lending for households in order to decelerate inflation, it can increase its reserve requirements for the banking sector. This means lower levels of liquidity for private banks when they have to deposit excess reserve to their regional central bank. Therefore in order to fill up this missing liquidity, the banks start to demand more cash on the reserve account markets from other banks. The rising demand of reserve cash causes the interest rate on them to rise, which is the Federal Funds Rate. Moreover when the Fed Funds Rate rises and reserve cash becomes more expensive for private banks, they have to make up for the deficit by transferring the rise of the Fed Funds Rate into their own lending interest rates. This makes borrowing less desirable for households and businesses and therefore causes pressure for inflation rise to calm down. This chain of events is part of conventional conduct of monetary policy. However it illustrates how the Federal Reserve does not just simply set out a

new level for its main directing interest rate, but it has to put in effort in order to move the rate within its desirable window.

Second of the Fed's three policy tools is its discount lending operations. In practise it means private banks' direct lending from their regional central bank. In these operations the Fed uses a different interest rate than the Fed Funds Rate. The discount lending program is called the Discount Window, and it is mainly meant to be used during times of economical distress. However alterations to the supply of discount lending and its interest rate have significant effects to the Fed Funds Rate as well so it still is an important part of the Fed's conduct of monetary policy. (Mishkin 2000: 212–213.) For example if the Fed decides to increase the supply of discount loans and lowers their interest rates, the Discount Window becomes more attracting source of cash for private banks. When banks start to increase their discount borrowing, the borrowed assets are transferred into their reserve accounts at the central bank, increasing their supply, which puts on pressure for the Fed Funds Rate to decrease.

The third monetary tool the Fed utilizes is its open market operations. Open market operations are the Fed's main tool that it uses to control the supply of money within the US economy. In practice these operations mean purchases and sellings of bonds and securities. Open market operations could in principal be targeted to any type of asset classes, but in order for them to be efficient and affective, the Fed usually targets these operations to highly liquid short-term asset classes that have low transaction costs. In addition with the aim to control the money supply within the economy, the open market operations are an important tool for the Fed to affect the Fed Funds Rate as well. This effect is achieved because when the Fed buys or sells securities, the transactions happen between the reserve accounts at the regional central banks and therefore affects the Fed Funds Rate as well. (The Federal Reserve Board 2013.) Typically the open market operations are targeted to US government bonds, because their markets are the largest and most liquid markets among all asset classes in America. This means that the Fed's open market operations do not affect or interfere with the price levels of the bond markets. In addition to the bond transactions, the Fed also trades a lot with so called repurchase agreements (repos). Repos are very short-term loan agreements, which the Fed uses to make small adjustments to the supply of cash on the reserve accounts markets. This enables the Fed to keep the Fed Funds Rate in control on a daily basis within its desired fluctuation range. (Mishkin 2003: 178–180.)

### 3.3. Federal Reserve's actions during past recessions

Even though central banks use monetary policy tools to smoothen out economical cycles and to promote steady growth, history has shown that economies have faced times of recessions and even depressions despite the existence of centralized monetary policy authorities. As have central banks around the world, so has the Fed many times launched aggressive monetary actions during economical slowdowns to help its domestic markets to recover towards new growth paths. In the past actions within the Fed's traditional policy regime have been sufficient to help its economy recover and conventional monetary has been seen as an efficient tool to solve economical problems during recessions. The financial crisis of 2008 proved to be the first recession where traditional monetary policy framework was not adequate any more to solve all of the problems the economy was facing and the policy actions that took place were significantly apart from the conventional regime. In order to comprehensively understand the contrast of the new monetary actions during the financial crisis, it is appropriate to briefly look into some previous recessions in America and examine the Fed's reactions to them.

Since its foundation, the Federal Reserve faced its first significant challenge in the late 1920's, when the US stock market started showing signs of overheating. In the 1920's stock investing had become more and more popular among common citizens and banking regulation had been liberated significantly. This had lead to a strong upward trend in the stock markets and the prevalent sentiment was positive about the continuation of the stock boom. As the stock price bubble grew larger the Fed was considering tightening its discount-lending program in order to calm down the securities market hike. Regardless of the heating stock markets, Mishkin (2003: 231–232) states that the Fed did not tighten the program, because it was too concerned that it would cause negative effects to private bank lending for businesses, and the tightening was postponed till the August of 1929. At that point the stock boom had already formed a bubble and a hike in the discount lending interest rate was not sufficient to calm the market crash down, but it actually worsened the circumstances for households and businesses while the recession was beginning. (Mishkin 2010.)

So as Mishkin (2010) states, the Fed's monetary policy was too easy before the Great Depression and did not prevent the overheating of the markets. During the recession, the Fed also took a passive role in its policies. When the stock market crashed, it caused a panic among citizens and significant amounts of bank runs, which eventually led to over

30 per cent of the commercial banks in the US filing for bankruptcy during the recession. Even though the banking sector was struggling with significant liquidity problems, the Fed decided not to take its assumed role as the lender of last resort to help the suffering banks. Mishkin (2003) states that the Fed did not fully understand how the bank bankruptcies would affect to the supply of funding in the financial markets. According to Mishkin, the central bank saw the bankruptcies more as an unfortunate result of the depression, but not as a factor that would deepen the slowdown even more. All together Mishkin sees the Fed's role before and during the Great Depression as quite passive.

After the years of depression, the Second World War affected the monetary independency of the Fed, when the US government started issuing substantial amounts of bonds to fund its wartime operations. In order for the government to afford these high levels of new debt, the Fed agreed to hold the market interest rates at a relatively low level. To achieve this the Fed utilized its open market operations and started purchasing securities form the markets. After the war had ended the Fed kept holding the market rates at a low level, which was possible due to low pressures for interest rates to rise after the war. (Mishkin 2000.) The time of low interest rates was cut short by the Korean War in 1950. Beginning of another war gave pressure for market interest rates to rise and the Fed was forced to increase the supply of money in order to keep the market interest rates in its control. The rapid increase in money supply resulted an unwanted rise in inflation during 1950 and 1951. The accelerating inflation made it impossible for the Fed to keep its promise for the US government to keep market interest rates low and the Fed ended up taking back its full autonomy of its conduct of monetary policy. (Mishkin 2000: 232–233.) The redeeming of the Fed's full autonomy was agreed in the Treasury Fed Accord –contract in 1951. The contract enabled the Fed to tighten its monetary policy quickly and decelerate inflation through hikes in the Fed Funds Rate. The Fed however agreed to prevent sudden and rapid interest rate hikes in the future for the government. The contract specified the Fed's new policy objectives to include targeting maximum employment and low inflation levels. (Fed of Philadelphia 2014.)

The Fed ended up in troubles with its new objectives in the beginning of 1970's, when the central bank was aiming to reach its maximum employment goal through easy monetary policy. This however caused the money supply to grow faster in contrast with general economic growth resulting in accelerated inflation. Simultaneous rise in oil prices and increased consumer spending rushed inflation even further. The rapid growth of inflation ended up driving the economy into recession and caused unemployment to rise significantly. In other words the economy had reached a state of stagflation where inflation rises together with economic slowdown. To stop the stagflation spiral the Fed

once more ended up raising its Fed Funds Rate aggressively. Even though the recovery was not painless, the central bank was successful to restore balance and growth into the economy through its conventional monetary tool. (Fed of Philadelphia 2014.)

Out of its three conventional monetary tools, the Fed ended up using discount lending and open market operations during the nations deepest single day stock market crash in 1987. October 19th, as commonly referred as the Black Monday, the Dow Jones Industrial index dropped suddenly by 23,2 per cent, causing a state of panic in the stock markets and the credit markets between stock brokerage entities were in danger of freezing up completely. (Mishkin & White 2002.) In order to avoid a complete systemic crash in the markets and further plummeting of asset classes, the Fed had to step in as a provider of liquidity. In the following day of the Black Monday, Alan Greenspan, the current chairman of the Fed at that time, informed before market opening that the Fed was willing to offer discount lending for private banks, who would then pass the funding on for stock brokers. According to Mishkin (2000) the Fed wanted to send a message for the markets that the central bank was willing to offer as much of liquidity as needed for the markets to continue operating normally. The Fed's message was received well by the markets, calming the systemic stress down and restoring trust between the credit providers and stockbrokers. In addition the Fed did security purchases for 17 billion dollars to support the banking sector. After the largest shock cleared out, it turned out that market entities did not even borrow significant amounts loans through the discount window in the following days. The Fed had succeeded to calm the markets down by just announcing the availability of excess liquidity. (Mishkin 2000; Mishkin & White 2002.) In summary the Black Monday proved the open market operations as an effective liquidity providing channel, but also showed the power of promises made about the Fed's extensions to its Discount Window –program.

# 4. The Federal Reserve and the financial crisis

The previous chapters have shown how the build up to the financial crisis entailed many different pieces and problems within the US economy. Even though the crisis involved familiar characteristics as previous economic bubbles in the past, the housing market bubble had formed systemic risk factors around it that entailed completely new challenges for the policy makers to face when the crisis begun. The Federal Reserve's conventional monetary tools had been sufficient previously to aid the economy in times of economical distress, but the financial crisis of 2008 proved to be a challenge for the central bank that demanded completely new adjustments to its conduct of monetary policy. This chapter goes through the events around the beginning of the crisis and investigates the Fed's actions and responses to it.

## 3.1. The first phase and conventional monetary policy

As the US housing markets started crashing down, marking the beginning for Mishkin's described first phase of the financial crisis, the Fed's first monetary responses came in late 2007 when it started easing its policies to provide more trust and liquidity into the markets. When the real estate related securities markets started having significant troubles, the Fed lowered its Fed Funds Rate target by half a per cent to 4,75 per cent, in order to ease the pressure for credit markets to freeze up too much. As a support for the lower Fed Funds Rate, the Fed made adjustments to the discount-lending program as well. In late 2007 the Fed cut its discount-lending rate by half to 5,25 per cent. As an extra incentive for the markets, the central bank also widened the range of assets that qualified as guarantees for the discount loans. (Mishkin 2010.)

In 2008 the Fed continued lowering its directing interest rate aggressively, and by April the Fed Funds Rate stood already at two per cent (Mishkin 2010). In just over six months the Fed Funds Rate had been lowered by over three per cent, which according to Bernanke (2009a) can be considered as highly rapid pace in historical perspective. In March 2008 the Fed also kept lowering its terms for the Discount Window –program, as it lowered the interest on discount loans to only 0,25 per cent higher level than the Fed Funds Rate (Mishkin 2010). Bernanke (2009a) states that by lowering the Fed Funds –

and the discount lending rate, the Fed aimed to cushion the effects from the real estate market for the whole economy and help the financial sector. By providing extra liquidity, the Fed also wanted to calm down concerns about the availability of funding in the markets, if the levels of trust and confidence were to drop in the markets. All this was to ensure there would not be a sudden selling wave of asset, which would have worsened the crisis even further.

However the Fed had to put in extra effort in order to support the proper functionality of its Discount Window –program. This was due to certain aspects of this monetary tool during economic slowdowns. As Bernanke (2009a) points out, monetary easing through the Discount Window can be problematic, since no entity can be forced to apply for new discount loans, no matter how affordable the terms might be. Mishkin (2010) also describes how it can be problematic that discount loans are only eligible for traditional banks, not for example for investment banks. In addition entities may be afraid of sending a negative message for the markets about their health if they apply for new discount loans. In order to ease the issue of banks being afraid of lending out liquidity from the central bank and sending out negative signals simultaneously, the Fed founded a program called the Term Auction Facility (TAF). The TAF-program was to fulfil the same purpose that the traditional discount lending did, but the credit was now offered in silent auctions, so that the market entities did not know the counterparts that were in need of the extra liquidity. The TAF-program proved to be a successful endeavour and was far more popular than the traditional discount lending. Up until March 2008 the Fed was able to lend out new loans worth 460 billion dollars. (Cecchetti 2008: 20–21.) In March 2008 the Fed also widened its liquidity lending by allowing investment banks to participate in the Discount Window –program as well. Simultaneously the Fed also extended the maximum maturity of the loans to 90 days from the traditional 30 days. (Board of Governors 2008a.)

In addition with actions to provide more liquidity for the economy, the Fed had to make significant monetary decisions regarding individual struggling financial entities. The first entity that faced substantial pressure in the distressed markets to keep functioning normally was the investment bank Bear Stearns. As was described in the previous chapter on events surrounding the financial crisis, Bear Stearns was facing serious liquidity problems in early 2008. (Mishkin 2010.) The bank was holding a significant amount of subprime related mortgage securities, which had been dropping in value during 2007. In early 2008 the markets started loosing fate in Bear's solvency rate, which started creating a "domino-effect" among different financial institutions in their willingness on providing funding for Bear Stearns. When other banks did not provide any more short-

term funding for Bear, and Bear's own clients started withdrawing assets from their accounts, the bank was forced to inform the Securities and Exchange Commission on March 13. 2008 that it would not be able to operate on the following day anymore. Bear's chief executive officer Alan Schwartz tried to keep the bank alive by requesting a 30 billion dollar loan from JP Morgan, which had a large ownership in the bank already, but JP Morgan refused to support Bear Stearns without any aid from the Fed. During the following weekend it became clear that Bear Stearns would not be able to do business anymore on the following Monday. During the weekend the Fed came to a conclusion that Bear Stearns' bankruptcy would be a too dangerous event on the linked financial markets, and decided to broker a deal, where JP Morgan would buy Bear Stearns. (FCIR 2011: 286, 288–290.)

Settlements like this, where the Fed financially aids a private bank buying another entity were not completely unprecedented in the central bank's history. Even though the central bank tries to avoid intervening with the markets as much as it can, the JP Morgan transaction was not in conflict with the Federal Reserve Act either, because the act allows the Fed to aid or contribute to a sale of a financial institution in extreme conditions, if a buyer cannot be found from the domestic or foreign markets. (FCIR 2011: 290; Board of Governors 2013.) The Fed defined the price per share for Bear Stearns to be two dollars, against the four dollars suggested by JP Morgan, because the Fed wanted to send a message, that it was not rewarding Bear Stearns for immoral actions by saving it, but to ensure the stability of the financial markets. In order to make the deal happen, the Fed did have to take 30 billion dollars worth of risky assets under its own balance sheet, out of which JP Morgan only was responsible for 1,1 billion dollars. (FCIR 2011: 290.) This part of the deal was among the first examples of the Fed's new monetary policies, which had never been seen before in the central bank's history (Mishkin 2010).

Even though the Fed had to break its traditional code in its conduct of monetary policy with Bear Stearns, Mishkin (2010) states that the Fed did reach its goals with the transaction and the markets calmed down in March 2008. For instance the TED-spread, which illustrates the level of credit risks in the markets, quickly dropped back to the levels where it had been before the problems at Bear Stearns had become known in the markets. Just before JP Morgan had bought Bear, the TED-spread had doubled in its value. Overall the Fed was able to stabilize the economy during Mishkin's described first phase of the crisis using its conventional monetary policy tools, with the exceptions of adjusting its discount lending operations and brokering the deal with Bear Stearns. According to Bernanke (2009) the Fed was able to improve the availability of funding

and mitigate lack of trust in the markets during 2007. Bernanke also states that the Fed was able to lower the unemployment levels that had risen in 2007 and the economy had reached a stable state in mid 2008 with inflation starting to accelerate once again. Mishkin (2010) describes that economical forecasts in the second quarter of 2008 were showing signs of a moderate growth towards the end of the decade and the prevailing sentiment was that the worst slowdown was already passed. At that time arguments were even being made for tightening monetary policy, because the nation's consumer price indexes showed pressure for acceleration in the second quarter. Kohn (2008) states that the inflation pressures derived mainly from recent hikes in food and oil prices, where weak supply levels were raising their prices.

The Fed's monetary actions during the first phase of the crisis have also been criticized. Especially the aggressiveness of the central bank's monetary easing in 2007 has raised counter arguments. As described by Bernanke (2009), the Fed did make extraordinary efforts to lower market interest rates in 2007. Buiter (2013) sees this as questionable. Buiter expresses his concerns on Wall Street's authority over the central bank and suggests that the big financial institutions were successful in scaring the Fed about the possibility of a stock market crash, were the interest rates not brought down rapidly. Buiter therefore sees the aggressive reaction by the Fed to lower the rates too strong. Furthermore Feldstein (2008) shares Buiter's view of the rate drop being too rushed. He states that the interest rate levels were too low in 2007 and 2008 and gave too much room for inflation pressures to rise. According to Feldstein (2008) the Fed's arguments for the interest rate cuts were not justified, because when the economic growth slowed down in 2007, lower interest rates do not fulfil their main purpose of promoting more consumption and higher wages. Instead the rate cuts present themselves straight as rising prices in commodities such as oil and food. Feldstein states that when the interest rates are low, investors add the portions of commodities in their portfolios to make up for the losses in interest rate instruments. Furthermore when the price of crude oil rises, the agricultural sector starts emphasizing products that need ethanol in their production such as corn, lowering the production and supply of other food, which then raises the overall price levels. As mentioned before, Kohn (2008) found evidence for this and emphasized that the inflated prices of oil and food were significant concerns in the mid of 2008.

Furthermore Armantier (2008) describes how the Fed actually failed with the adjustments to its discount lending operations during 2007. According to Armantier the adjustments to the program did not increase the demand for the discount loans nearly enough in order to prevent a credit crunch from happening in the markets. This was

because the cuts to the interest rate and increases in the maturities of the loans were not enough to make the loans seem desirable enough for private institutions. Armantier states this was because of two reasons. Firstly the discount lending program was problematic for private banks during that time, because applying for a loan simultaneously sent out a negative signal of the bank's health for the markets. Secondly the rates for the discount loans were too close to the rate levels of the interbank lending, which banks traditionally use to finance their day-to-day operations, so lending assets from the interbank markets seemed far more desirable. The problem was that the available liquidity in the interbank markets was not sufficient during those days, which caused problems for banks in their day-to-day operations.

The Bear Stearns rescue operation was criticized widely as well in early 2008. The consequences of letting Bear Stearns file for bankruptcy would have been difficult to evaluate before hand, but for a government entity to save a private financial institution always bears within it risks of aggregating more moral hazard into the system. Roberts (2008) discusses the problem of moral hazard with the final selling price of Bear Stearns to JP Morgan as well. As mentioned before, the Fed tried to send a warning signal for the markets by setting the selling price of Bear only at two dollars per share, instead of the suggested four dollars by JP Morgan. In the aftermath of the deal, the final price turned out to be five fold at ten dollars a share, which the Fed also went along with. Roberts (2008) sees this as a very bad example of the kind of politics a central bank can present itself in front of the financial markets.

## 3.2. The second phase and new unconventional monetary actions

Even though the Federal Reserve had had to make adjustment to its traditional monetary policy tools and expand its programs in order to inject liquidity more effectively into the markets, these adjustments were only short-term actions and moderate on their scale to what the central bank did after the so-called second phase of the financial crisis begun when Lehman Brothers filed for bankruptcy on September 15$^{th}$ 2008. This chapter goes through the fallouts the bankruptcy of the nation's fourth largest investment caused and how the central bank implemented new completely unconventional monetary tools in order to address the issues the economy was facing.

When Lehman Brothers filed for bankruptcy the effects transferred directly to other financial institutions that had participated in the same mortgage related securities mar-

kets as Lehman. The systemic market crash hit hardest on the world's largest insurance company AIG. AIG had been heavily active in selling of credit default swaps and a large portion of them had underlying assets on Lehman Brothers' balance sheet. As Lehman filed for bankruptcy, all the MBS –and CDO products under Lehman's balance sheet became worthless, which meant that overnight AIG was due to billions of dollars of payments for investors who had bought AIG's credit default swaps. AIG's liquidity simply was not large enough to satisfy this large amount of payment demands. AIG's liquidity troubles became public knowledge quickly and the insurance company's credit ratings were lowered. The lack of trust towards the company meant that other financial institutions were not willing to provide any excess liquidity for it. Lending out cash through the Fed's lending programs was not an option either, since even though the central bank had earlier expanded its loan availability for investment banks, insurance companies were still not eligible for monetary authority's support. It was clear that AIG was not going to be able to do business for long at that point. (Mishkin 2010: 6; The FCIR 2011: 346, 349.)

The troubles with AIG posed another big decision point for the Fed. It had to decide whether to stick with the same policy it had chosen with Lehman Brothers, or to come to the insurance company's aid. The New York Fed representative LaTorre described the up and downsides for the Federal Reserve in 2008 on the AIG rescue decision. LaTorre emphasized that a decision to let AIG file for bankruptcy as well could cause serious systemic failures among financial institutions due to liquidity problems and trust issues in the US and in Europe as well. AIG's failure could have also caused significant distress in the CDS-markets. On the other hand the decision to aid AIG was highly complicated, since it was difficult to evaluate the total amount of monetary help the company needed to cover its liquidity demands, because of the complexity of the CDS contracts and their linkages. In addition the Fed's decision to help out another financial institution just after letting one fail the day before was conflicting and prone to cause more possible incentives for unmoral behaviour in the financial sector. After consideration on the 16th of September 2008 the Fed decided to rely on the clause in the Federal Reserve Act allowing it to aid financial institutions again, and granted an 85 billion dollar loan for AIG for it to survive its on going liquidity issues. The Fed justified it's the decision on the concerns of the risks for the already unstable financial system, pressure for lending costs to rise and for a threat for weakening position for households. (FCIR 2011: 348, 350.)

Bailing AIG out did not however stop the advancing of the crisis in the financial markets. Mishkin (2010) brings out the next problem causing more liquidity problems in the

market, which was the crash of the Reserve Primary Fund. The Reserve Primary Fund is a very large mutual fund in the US that financial institutions invest in. The philosophy of the fund relies heavily on very safe and steady investment instruments, such as top rated short-term government and corporate bonds. Therefore the fund is threated as a substitute for a bank account with a slightly higher yield expectation. (Bernanke 2012.) In 2008 the fund held a large portion of Lehman's bonds, meaning that the investment bank's failure affected the fund's liquidity significantly as well. This caused concerns towards the funds ability to function appropriately, which triggered a withdrawal wave of assets from the fund. The fund quickly lost 90 per cent of its assets due to withdrawals. During September and October in 2008 banks took out their investments from other mutual funds as well trying to hedge their position in the markets, but Mishkin (2010) emphasizes that this actually ended up worsening the banks' situation. This was because the notable investments banks normally have on the mutual fund accounts generate an important source of cash flow for the banks deriving from interest rate yields from the funds. These yields act as insurance for daily liquidity for the banks. Now when the banks withdraw their investments from the funds, they did not have that incoming cash flow for the months to come anymore. The Fed reacted aggressively to this problem in co-operation with the US treasury, and offered to provide excess loans for institutions that would keep investing their cash back to the mutual funds. In addition the treasury promised to guarantee all the new deposits being made into the mutual funds. (Bernanke 2012.)

In spite of the Fed's lending operations, the aid for AIG and the support for the mutual funds, governing authorities were still unable to avoid the credit markets from freezing up. According to Bernanke (2009) the credit crunch of the financial markets drove the US economy into a recession in late 2008. The crisis in the credit markets caused asset classes' values to crash and banks stopped lending for households and corporations. The weak state of the economy showed in weak consumption and investing of households and companies, rise in unemployment numbers and diminishing domestic production. To ease the situation in the credit markets the Fed initiated new lending programs to provide additional liquidity. These new programs included the "Term Asset-Backed-Security Lending Facility" (TALF) and "Commercial Paper Funding Facility" (CPFF). The TALF-program was targeted to aid households and small-sized businesses, with the Fed granting loans against high rated asset-backed-securities. The CPFF-program was established to support businesses directly. Within the program the Fed bought asset-backed-securities straight from financially healthy companies to support their liquidity.

In addition the Fed expanded it lending activities within the TAF-program. (Bernanke 2009b.)

As the recession kept worsening the Fed published a statement on the 25th of November in 2008 informing that the central bank would start an asset purchase program, which would be targeting mortgage-backed-securities directly. In the statement the Fed informed it would be performing asset purchases for 1,25 trillion dollars buying Fannie Mae and Freddie Mac MBSs. (Board of Governors 2008b.) The asset purchase program the Fed announced that day, diverged significantly from the conventional open market operations the central bank performed, which traditionally are targeted to short-term treasury bonds. Mishkin (2010) calls this type of asset purchasing activity with the widely used term quantitative easing (QE). In general, the term quantitative easing is used, when a central bank performs bond and security purchases, which expand the central bank's balance sheet and increase the supply of money within the economy.

In theoretical terms a central bank uses QE in attempt to affect the interest rate structure of the asset classes it is buying, which usually fore most are treasury bonds (Yu 2016). The interest rate structure is traditionally referred as the term structure of interest rates (TSIR). The TSIR tells how investors expect the future levels of interest rates to develop. The TSIR can be illustrated by using a yield curve describing the yields of the same asset with different maturities at a particular point of time. (Brealey, Myers & Allen 2011: 53.) Yu (2016) describes how the yield curve normally has a tendency to be upward sloping especially during times when the economy is on a steady growth path.

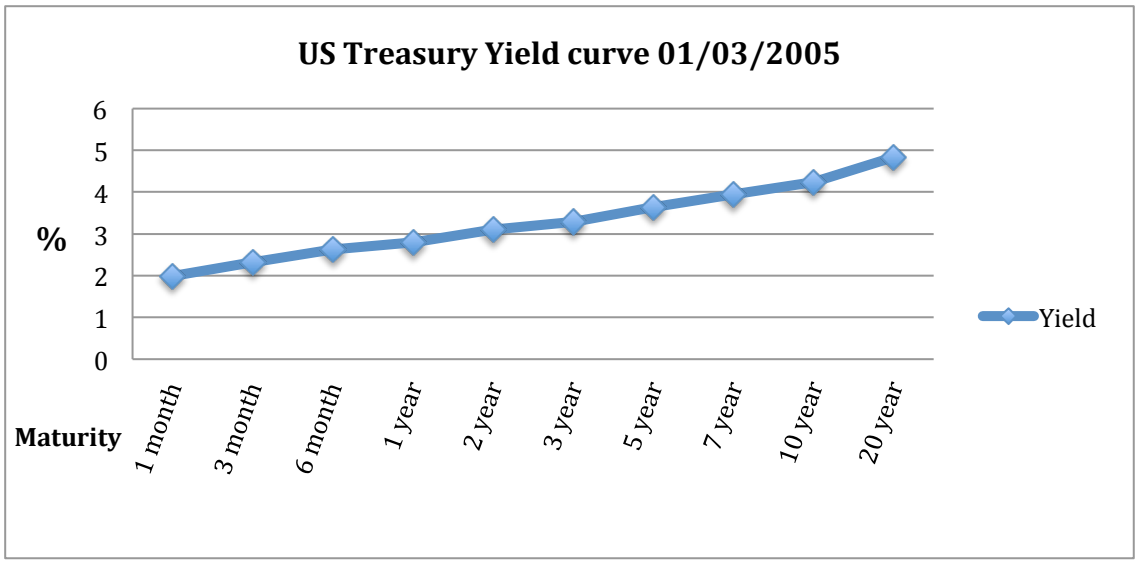


**Figure 4.** The Yield curve on US treasuries on 1st of March 2005 with 1 month to 20 years maturities.

Figure four illustrates the structure of US treasuries yield curve on the 1st of March 2005. From the figure four it can be seen that the longer the maturity gets on the US treasury bonds the higher the yield rises on them. This particular yield curve illustrates the situation, which Yu (2016) describes as the traditional shape of the curve. The shape of the curve is upward sloping because the longer the maturities grow on the bonds, the more uncertain investors become of the interest rate environments around the future maturity date and therefore demand a higher interest on the bonds.

Quantitative easing programs are conducted in attempt to alter this yield curve in the direction the central bank wants in order to adjust the credit markets towards the environment that is favourable for the central bank's on going state of monetary policy strategy. In times of economical distress the yield curve can be upwardly steep in the eyes of the central bank, because investors are uncertain about the future and loosing trust among each other, which causes investors to demand higher interest rates on the bonds, causing the yield curve to rise. With QE it is possible for the central bank to affect the yield levels by starting to purchase notable amounts of the bonds that contain too high yield levels at that time. (Chen, Curdia & Ferrero 2012.) When the central bank starts buying the specific bonds, their demand rises on the markets and their supply decreases, causing their price levels to increase. When the bonds become more valuable due to the rising price levels, investors do not demand as high yields from them anymore, causing the yield curve to flatten. If the central bank succeeds in flattening the yield curve, it should enable market interest rates to decrease all together, which makes credit more affordable for consumers and businesses and should give room for inflation to accelerate. (Yu 2016.)

Specific about the Fed's QE-program was that the purchases were targeted to MBSs. Bernanke (2012b) states that the Fed's goal was to support the MBS markets, which had been struggling heavily after the Lehman bankruptcy. The Fed's goal was to decrease the supply of MBS-products in the markets, which should cause their values to increase and lower the yield demands for them. The logic with the MBSs follows the same path as was described earlier by Yu regarding treasury bonds. If the Fed were to be able to increase the MBSs price levels, financial institutions would be able to use the securities better as collateral for credit transactions or liquidate them easier, which would all together ease the credit crunch in the markets. In addition the MBS purchases were made to support the housing markets in hopes that they would lower interest rate levels for

new mortgages and increase demand for new homes. This would give support for new home construction incentives as well. (Bernanke 2012b; The New York Fed 2010.)

As the Fed was initiating its first large scale asset purchases, the central bank was also making significant adjustments to the Federal Funds Rate. The Fed had been decreasing the main directing interest rate aggressively already in early 2008 as can be seen in figure five, but in December 2008 the Fed did something unprecedented and lowered the target level for the rate to be between zero and 25 basis points (0,25 per cent). Notable in the announcement of the new extremely low target range was that the Fed informed the public that the rate cut would be permanent for an undefined period of time and rates would not be lifted before the central bank could see clear improvements in economic activity and growth. (Board of Governors 2008c; Mishkin 2010.)

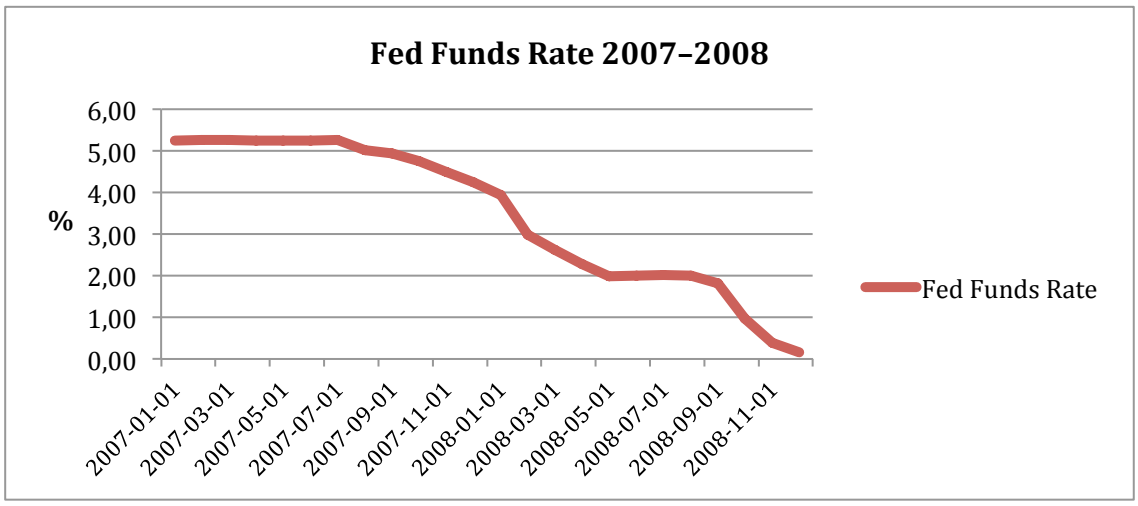


**Figure 5.** The Fed Funds Rate from January 2007 to December 2008

Mishkin (2010) and Yu (2016) emphasize that the promise by the Fed to keep the rates at zero bound level was an important monetary action that was made also to support the QE-program and to control the expectations of the markets for the future. Firstly according to Mishkin, the promise of the low rates for a long period of time increases confidence and trust in the markets, since investors can be more certain about the economical environment in the near future and financial institutions can forecast their interest rate exposures better. Secondly Yu (2016) points out that the commitment to the zero bound interest rate policy supports the QE program significantly as well. This is because it can build trust within the markets for the Fed's commitment to the QE program. If the markets fear that the Fed would have to raise interest rates if inflation would accelerate above the two per cent target, investors could not find the low levels of interest rates trustworthy in a longer time frame and the yield curve would not necessarily flat-

ten. Another concern could be that if the Fed would not stick with the zero bound interest rate level, the central bank would start losing significant amounts of money with the MBSs it buys. This is because when interest rates rise, they result in falling asset prices. This would also concern the MBSs under the Fed's balance sheet and in order to minimize its losses, the Fed might have to sell the MBSs back to the markets, which would reverse the monetary easing effect that was desirable when the securities were bought in the first place. So by committing to the low interest rate policy, the Fed would be able to strengthen the credibility of the QE program as well. (Yu 2016.)

By the end of 2010 the US economy kept still suffering of low growth and pressures for disinflation kept rising. In a statement released by the Federal Open Market Committee in November 2010 the committee described that household spending was still suffering due to high unemployment levels, low housing wealth and tight credit environment. Corporate investments had also started to decrease further and payroll additions were diminishing. The construction market on new homes continued to be depressed as well. These developments within the economy meant that the central bank was falling significantly behind from its duel mandate of sustaining a two per cent inflation level and maximum employment. Hence worth the Fed announced on November third 2010 that it would be extending its asset purchasing program it had started in 2008. The program would include new purchases of assets for 600 billion dollars by the end of the second quarter of 2011. (Board of Governors 2010.) The new quantitative easing program (QE2) differed from the QE1-program in the assets it was targeted to, since in 2010 the Fed started to focus the purchases into long-term US treasury bonds instead of the MBSs that the QE1 was associated with (Hennessy 2011). According to Bullard (2010) the Fed wanted to target longer-term treasury bonds specifically because the yield levels on them were still too high in the eyes of the central bank. Targeting the purchases on them could lower their yields down and help financial entities use them better as guarantees if their values would rise. The purchases would also inject more capital into the financial markets to support the credit environment. Along with the initiation of the QE2-program the Fed continued to inform that the Fed Funds Rate would still be kept at zero bound levels for an extended period of time in order to support the QE-program and the struggling economy (Board of Governors 2010).

During the end of 2011 and 2014 the Fed continued on its easy monetary policy path. This included additional asset purchases and continual commitment to the zero bound levels of the main directing interest rate. Firstly in late 2011 the Fed altered its asset purchasing programs by introducing a program where it intended to extend the bonds' maturities it was holding under its balance sheet (Board of Governors 2011). This pro-

gram has also been known as “Operation Twist”, where the Fed simultaneously sells shorter-term treasury bonds and buys longer-term bonds. This should theoretically flatten the yield curve on the bonds as bond yields should rise on the short-term bonds and fall on the long-term bonds. This happens because as the Fed starts selling shorter-term bonds, their supply on the market increases and their price levels falls down, causing investors to demand higher yields from them. If the Fed is then simultaneously buying long-term bonds their prices should rise due to their increased demand, causing their yields to drop. This yield curve alteration could then make long term credit more affordable for businesses for instance and promote economic growth. (Joyce, Miles, Scott & Vayanos 2012.) Along with the Operation Twist, the Fed also began buying MBS-securities again in late 2012 by 40 billion dollars per month to support the housing markets. Figure five illustrates the Fed’s asset purchases from 2008 till 2016 and the development of the Fed Funds Rate. As it can be seen from the figure five, the purchases of treasury bonds and MBSs have extended the central banks balance sheet significantly and the programs have lasted over five years. In addition it can be seen that the assets that have been purchased have not been sold yet back to the markets by the end of 2016 and hence worth the monetary stimulus effect is still in place and has not been reversed yet. Also the Fed Funds Rate still remains on a significantly low level.

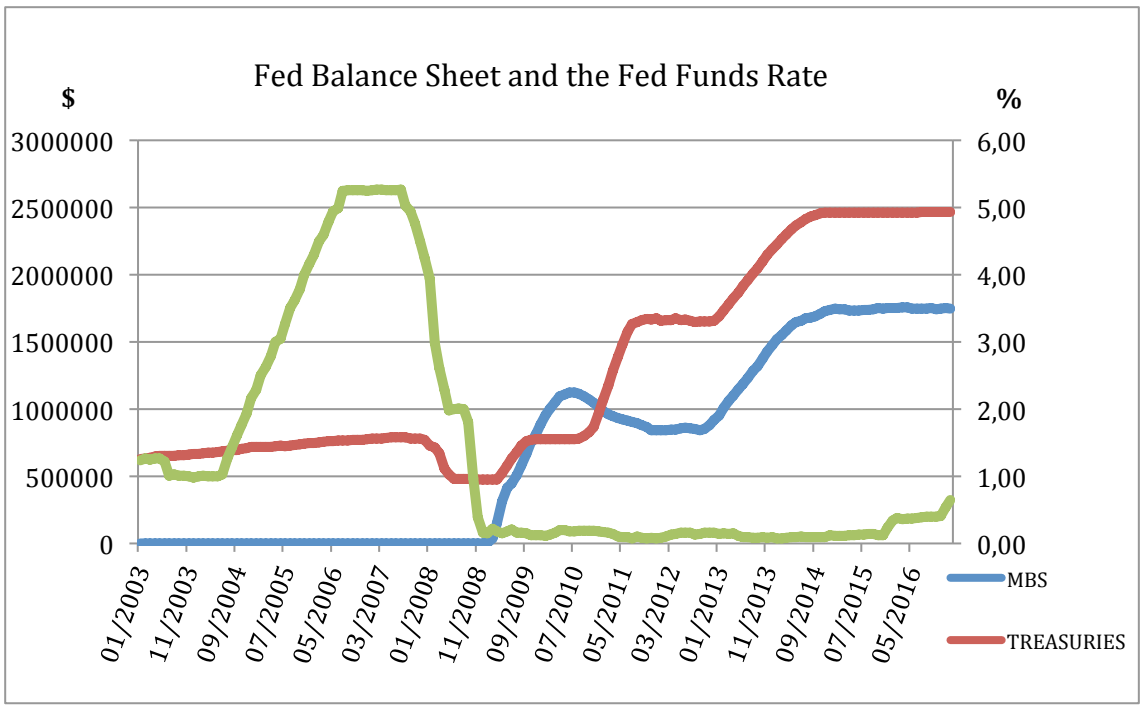


**Figure 6.** Amounts of MBS-securities and US treasuries on the Fed’s balance sheet (left) and the effective Fed Funds Rate’s development (right), (left: millions of dollars, right: per cent)

# 5. Empirical analysis

The empirical section of this paper is dedicated for examining the effects on the US economy that have followed from the unconventional monetary policy action taken by the Federal Reserve after the financial crisis of 2008. The examination is focused on two separate monetary actions and their different aspects, quantitative easing and zero bound interest rate policy. These two monetary tools were chosen because they are direct and significant expansions to the central bank's traditional tools and the departure from the conventional policies concerning these two tools has been substantial. The study on these tools is also valuable because other central banks around the world have conducted similar departures from their conventional policy regimes during this paper's research period, so the results of this paper can also be used as a comparative view for other nations' modern monetary policy conduct. Before moving to the empirical study and its results, the data used for the research and the study's methodology will be described.

## 4.1. Quantitative easing data

For studying the effects of quantitative easing as an explaining factor on economical developments, different portions of the asset purchases are being examined as well as all of the asset purchases as a whole. As mentioned by Blinder (2010), the Fed's asset purchases expand the monetary base of the whole economy. During the asset purchase program era, the monetary base of the US economy has indeed been increasing significantly and hence worth monetary base data from January 2009 till July 2016 is being used to examine the QE-programs as a whole. For examining the different asset purchases separately, the empirical research contains data of the development of the Fed's balance sheet. As mentioned before the asset purchases have included mortgage-backed-securities and different maturity US treasury bonds. Therefore data of the amounts of these securities are being used as well between 2009 and 2016. All QE data is derived from the St. Louis Federal Reserve's database and the figures are in a monthly form.

Along with announcements of the asset purchase programs, the Fed has been consistently reporting certain targets factors it has wanted to affect with the QE-programs. The factors that are included for this research have all been specifically named in the first

announcements of the separate asset purchase programs as main targets for the programs. These targets are inflation rate, MBS –and US treasury yields, household consumption, credit markets, mortgage lending and housing markets. All data is between 2009 and 2016 as monthly values and is collected from the St. Louis Federal Reserve database.

## 4.2. Zero bound Federal Funds Rate data

To examine the developments of the Fed Funds Rate and its effects on the economy, data of the effective monthly Fed Funds Rate is being used from sample between 2009 and 2016. The effective rate is being used so that the real fluctuations in the rate window can be included into the used empirical models. As described before the extended zero bound interest rate policy was implemented to support the QE-programs, but it also was practised to support the credit markets by lowering market interest rates. The Fed also hoped for it to support higher inflation and the housing markets. Therefore data of US inflation, amount of credit and levels of mortgage rates is being used in the empirical study. The possible effects of the Fed Funds Rate adjustments to the MBS and treasury yields data is also studied to see if there are any explanatory findings to be seen in contrast with the results of the QE data. All of the data being used in this study is described in appendix two and the time series figures of the data in appendix one.

## 4.3. Study methods

The effects of the quantitative easing programs and the zero bound interest rate policy on the US economy is studied by using ordinary least squares linear regression analysis and vector autoregressive models. Regression analysis should fit the purpose of the study well, because it allows examining two or more factors' influence on one another. In the different regression models the economical factors that were listed before, as the Fed's objectives to influence, will be the so-called factors to be explained or the dependent factors in the regression models. The explaining factors or the independent factors will be the different parts of quantitative easing and the zero bound interest rate data. The objective of the regression models is to see, how highly significant are the explanatory degrees of QE and the Fed Funds Rate –factors against the real economical

factors. The separate regression models are described in regression equations 2–12**.** In most cases, to achieve reliable results, lags are taken from the explaining factors, because monetary policy actions tend to take time to have an effect on the economy. The number of the lags is adjusted separately for each regression in order to achieve the most reliable results. In order to avoid issues with heteroskedasticity, robust standard errors are used in all of the regression models. In addition since the samples are not likely to be constant in time, logarithmic and first difference –transformations are made for the estimators to avoid non-stationary time series issues. Furthermore let it be mentioned that since QE also has an effect on the Federal Funds Rate as was discussed in the chapter on the Fed's monetary tools, QE and Fed Funds Rate will never be included in same regression models to avoid issues with multi-collinearity. Tables 1–11 display the most significant factors by their statistical t-values of the separate models. The statistical significance of a factor is marked with an asterisk (*). Ten per cent significance level is marked with one asterisk (*), five per cent with two asterisks (**) and one per cent with three asterisks (***). Tables 1–11 also show the values for the long-run propensity (LRP) -coefficients for each regression model. The LRP coefficients can give further indications of the monetary policy actions' effects on the economical factors on the longer run past the observation range. The examination of the LRP-coefficient is suitable in this case because monetary policy actions tend to have lagged effects on the economy. In order to derive the value for the LRP-coefficient, one lagged estimator needs to be taken from the dependent variable. But since the lagged value for the dependent variables coefficient may cause delusions for the regressions, these separate regressions are not taken into account or illustrated any other way than for the coefficient values that are needed for calculating the LRP-coefficient. The values for the LRP-coefficients are calculated using the equation 1, where the $\widehat{\beta_1}$ -factors are the estimators for the explaining factors and $\widehat{\beta_2}$ -factors are lagged estimators of the factors to be explained.

(1) $$LRP = \frac{\sum \widehat{\beta_1}}{1-\widehat{\beta_2}}$$

In support of the regression models, vector autoregressive (VAR) -models are also used. In this study the VAR-models are used study the relationship of one monetary policy action and one economical figure. The VAR-model shows how an unexpected shock in the monetary policy variable would affect the economical variable. (Suomen Pankki 1989: 13–15.)

## 4.4. Regression results

The first regression models study the effects of the quantitative easing programs as a whole. Therefore the explaining factor in the models is the monetary base, which takes into account every different asset purchase program.

(2) $d\ln CPI = \alpha + \beta_1 \sum_{t=1}^{9} d\ln Monetarybase_{t-1} + \beta_2 d\ln Monetarybase_{14} + \varepsilon$

**Table 1.** Coefficients for regression 2.

| Variable | Coefficient | std. error | t-value | p-value | | |
|---|---|---|---|---|---|---|
| const | 0,00110706 | 0,000336786 | 3,287 | 0,0018 | *** | |
| ld_Monbase_2 | 0,0468472 | 0,0108494 | 4,318 | 6,63e-05 | *** | |
| ld_Monbase_4 | −0,0138489 | 0,00812159 | −1,705 | 0,0938 | * | |
| ld_Monbase_5 | −0,0339827 | 0,0149396 | −2,275 | 0,0268 | ** | |
| ld_Monbase_7 | 0,0223626 | 0,00768056 | 2,912 | 0,0052 | *** | |
| ld_Monbase_14 | −0,0137331 | 0,00535580 | −2,564 | 0,0131 | ** | |
| R-squared: | 0,379608 | Adjusted R-squared: | 0,255530 | | | LRP: -0,0027 |

(3) $d\ln credit = \alpha + \beta_1 d\ln monetarybase + \beta_2 \sum_{t=6}^{14} d\ln monetarybase_{t-1} + \varepsilon$

**Table 2.** Coefficients for regression 3.

| Variable | Coefficient | std. error | t-value | p-value | | |
|---|---|---|---|---|---|---|
| const | 0,00479585 | 0,000709276 | 6,762 | 3,80e-09 | *** | |
| ld_Monbase | −0,0782250 | 0,0318817 | −2,454 | 0,0167 | ** | |
| ld_Monbase_10 | −0,0719817 | 0,0355723 | −2,024 | 0,0470 | ** | |
| ld_Monbase_14 | −0,0606321 | 0,0249751 | −2,428 | 0,0178 | ** | |
| R-squared | 0,458785 | Adjusted R-squared | 0,379195 | | | LRP: -0,0815 |

(4) $d\ln consumption = \alpha + \beta_1 d\ln monetarybase + \varepsilon$

**Table 3.** Coefficients for regression 4.

| Variable | Coefficient | std. error | t-value | p-value | | |
|---|---|---|---|---|---|---|
| const | 0,00317745 | 0,000325366 | 9,766 | 7,88e-16 | *** | |
| ld_Monbase | −0,0397343 | 0,0177042 | −2,244 | 0,0272 | ** | |
| R-squared: | 0,176765 | Adjusted R-squared: | 0,167718 | | | LRP: -0,021 |

Regressions two, three and four study the relationship between quantitative easing and three separate economical factors that the Fed has mentioned as its targets to influence through out all of the asset purchasing programs. The Fed has hoped that QE would

promote higher inflation, which would suggest a positive relationship between monetary base and inflation, represented here by the consumer price index (CPI). The results of the regression model two do not however signal an expected relationship between these factors during 2009 and 2016. The coefficients showing any significant explanatory levels in table one have low values and are not consistent in terms of their positive or negative signs. For instance even though the two month lagged coefficient is positive as the central bank would hope, the fourth and fifth month's coefficients are negative and reverse the positive effect the expansion in the monetary base has done for inflation earlier. The LRP-coefficient also shows that the changes in the monetary base would actually have a small but negative effect in contrast with inflation on the long run. The R-squared and the adjusted R-squared –coefficients, which indicate the fraction of the variations in inflation that is explained by the model, confirm however that the size of the monetary base has explained a significant portion of the variance in inflation during the sample period.

Regressions three and four indicate same types of results in terms of the signs of the coefficients as the inflation model did. The Fed informed constantly that they hoped QE to be a promoter for higher consumption and lending activity in the country. Equation three compares the development of bank lending and the monetary base and only ends up signalling a negative 0,07 per cent relationship with the two factors during 2009 and 2016 as described in table two. Only two lagged coefficients show statistically significant values and their signs are negative as well. The R-squared values are relatively high which does indicate that monetary base has a significant role in bank lending. It seems however that even though the Fed's asset purchases have freed up new capital for the banks to lend out for consumers and businesses, the excess reserves have not transferred into new loans on a significant level.

Equation four's results follow the pattern of models two and three as could be expected since higher inflation would also need higher levels of credit and consumption. The model four suggests that there has been a negative relationship between consumption and monetary base developments during the sample period and the coefficient only suggests a negative 0,04 per cent relationship between the two factors. The R-squared values in table three suggest that there is still some value for monetary base as an explaining force behind consumption.

Equations five, six and seven study the effects of monetary base developments on another important target of the Fed's monetary policy between 2009 and 2016, the housing markets. The developments in the real estate sector are investigated through changes

in average mortgage rates, housing prices and sales of new homes, since these are factors that the central bank has informed as targets that the QE-policy should affect.

(5) $$dmortgagerate = \alpha + \beta_1 \sum_{t=1}^{4} d\ln Monetarybase_{t-1} + \varepsilon$$

**Table 4.** Coefficients for regression 5.

| Variable | Coefficient | std. error | t-value | p-value | |
|---|---|---|---|---|---|
| const | −0,0267555 | 0,0161849 | −1,653 | 0,1021 | |
| ld_Monbase | −0,438744 | 0,709018 | −0,6188 | 0,5377 | |
| ld_Monbase_1 | 0,528502 | 0,626545 | 0,8435 | 0,4014 | |
| ld_Monbase_2 | 1,41943 | 0,447191 | 3,174 | 0,0021 | *** |
| ld_Monbase_3 | 0,117551 | 0,701780 | 0,1675 | 0,8674 | |
| ld_Monbase_4 | −0,524482 | 0,475145 | −1,104 | 0,2729 | |
| R-squared | 0,134730 | Adjusted R-squared | 0,082605 | | LRP: 1,044 |

(6) $$d\ln Housepriceindex = \alpha + \beta_1 \sum_{t=1}^{18} d\ln Monetarybase_{t-1} + \varepsilon$$

**Table 5.** Coefficients for regression 6.

| Variable | Coefficient | std. error | t-value | p-value | |
|---|---|---|---|---|---|
| const | 0,00328184 | 0,00211896 | 1,549 | 0,1275 | |
| ld_Monbase_1 | 0,0509134 | 0,0274945 | 1,852 | 0,0697 | * |
| ld_Monbase_2 | 0,0761949 | 0,0241588 | 3,154 | 0,0027 | *** |
| ld_Monbase_3 | 0,0802224 | 0,0349719 | 2,294 | 0,0259 | ** |
| ld_Monbase_6 | −0,0616636 | 0,0295764 | −2,085 | 0,0420 | ** |
| ld_Monbase_7 | −0,0751237 | 0,0307177 | −2,446 | 0,0179 | ** |
| R-squared: | 0,375014 | Adjusted R-squared: | 0,146654 | | LRP: -0,083 |

(7) $$d\ln New\,\text{hom}\,esales = \alpha + \beta_1 \sum_{t=1}^{15} d\ln Monetarybase_{t-1} + \varepsilon$$

**Table 6.** Coefficients for regression 7.

| Variable | Coefficient | std. error | t-value | p-value | |
|---|---|---|---|---|---|
| const | 0,0131541 | 0,00760620 | 1,729 | 0,0888 | * |
| ld_Monbase | −0,556025 | 0,429163 | −1,296 | 0,2000 | |
| ld_Monbase_1 | 1,09079 | 0,415279 | 2,627 | 0,0109 | ** |
| ld_Monbase_3 | −1,31385 | 0,528835 | −2,484 | 0,0157 | ** |
| ld_Monbase_8 | −0,682983 | 0,270257 | −2,527 | 0,0141 | ** |
| ld_Monbase_14 | −0,775680 | 0,354893 | −2,186 | 0,0327 | ** |
| R-squared: | 0,404897 | Adjusted R-squared: | 0,248804 | | LRP: -0,601 |

Table four shows that the size of the nation's monetary base has had quite a low explanatory force over the development of the interest rates on mortgage lending. As the monetary base expands, banks should have more assets available for lending and the supply

of mortgage loans should increase, causing the mortgage rates to fall. This cannot be seen in the signs or significance of the coefficients in table four as only one coefficient shows statistically significant results implicating a positive relationship between an increase in monetary base and the development in mortgage rates. Both the one significant coefficient of two-month lag and the LRP-coefficient suggest that during the sample period a one per cent rise in monetary base has increased mortgage rates by over one unit.

Equation six studies how much the monetary base has promoted growth in the nation's house prices. The monetary base has had an effect as an explaining factor to the housing price developments according to the R-squared coefficients as described in table five. The results still show a weak correlation however judging by the coefficient values. With one month to three months lags, the coefficients show expected positive values as the Fed hoped for the QE-programs to promote stronger real estate markets. The next significant values are found for the six and seven-month lags, which have negative signs indicating a reversing effect for the positive price development in the earlier months. The LRP-coefficient has a negative value and actually indicates that the expansion in the monetary base has a negative 0,6 per cent effect over the long run for the housing prices.

The Fed has also informed that the QE-programs were initiated to promote stronger environment for new home sales. The outcomes of equation seven in table six do not give strong results for the QE-program since all except one of the coefficients show negative correlation between QE and new home sales and the LRP-coefficient also has a negative sign. In addition whereas the coefficients housing prices were relatively low, the values for new home sales coefficients are many times higher. For instance the overall coefficient for the equation suggests that a one per cent rise in the monetary base results in a 0,56 per fall in new home sales.

As discussed earlier on the initiations of the QE-programs and quantitative easing's general theory, one of the Fed's main goals was to affect the interest rate levels on US treasuries and MBS-securities. Equations eight through ten study the QE programs more closely, and separate the treasury and MBS asset purchases. The variables chosen to be studied are the yield to maturities (YTMs) of the different asset classes because these rates incorporate market expectations of these rates daily and determine their market price levels. Therefore they should represent the response to the asset purchases well.

(8) $dMBS30YearYTM = \alpha + \beta_1 \sum_{t=1}^{15} d\ln MBSheldbyFed_{t-1} + \varepsilon$

**Table 7.** Coefficients for regression 8.

| Variable | Coefficient | std. error | t-value | p-value | |
|---|---|---|---|---|---|
| const | −0,0436778 | 0,0182261 | −2,396 | 0,0196 | ** |
| ld_MBSheldbyFed_2 | −7,96525 | 2,03567 | −3,913 | 0,0002 | *** |
| ld_MBSheldbyFed_3 | 11,2811 | 2,99670 | 3,765 | 0,0004 | *** |
| ld_MBSheldbyFed_4 | −14,6541 | 4,35313 | −3,366 | 0,0013 | *** |
| ld_MBSheldbyFed_5 | 9,90598 | 3,79700 | 2,609 | 0,0114 | ** |
| ld_MBSheldbyFed_7 | 8,76339 | 3,55158 | 2,467 | 0,0164 | ** |
| ld_MBSheldbyFed_8 | −6,15682 | 3,68600 | −1,670 | 0,1000 | * |
| ld_MBSheldbyFed10 | −5,18312 | 2,84076 | −1,825 | 0,0730 | * |
| ld_MBSheldbyFed15 | −1,37258 | 0,576637 | −2,380 | 0,0204 | ** |
| R-squared : 0,391 | Adjusted R-squared: 0,231 | | | | LRP: 3,10 |

The equation eight concerns the MBS purchases directly in contrast to the development of 30-year MBS market yields to maturity. The maturity of 30-year securities was chosen since longer maturity securities tend to respond more strongly into chances in interest rate environments. The Fed informed that it was doing the asset purchases in order to increase the assets' values and therefore lower their yields. This would suggest the coefficients to have negative signs. This does not hold constantly however according to the results in table seven. The first lags of the independent variable, which represents the amount of MBS-securities under the Fed's balance sheet, show that the effects shift from negative to positive from two till five months time. It seems that the MBS-purchases have a more consistent negative affect on their yields on a longer time period, since the eight, ten and 15 month lags show negative signs with statistically significant results. The LRP-coefficient also has a positive sign suggesting a 0,03 unit change in the MBS yields if the amount of MBSs rises by one per cent in the Fed's balance sheet. The R-squared values show nevertheless that the MBS purchases have played a significant role in the development of the MBS market yields.

Equation nine studies the effects of the US treasury purchases. The R-squared values for equation nine in table eight show that the US treasury purchases have had a significance effect on explaining the development of the US treasury yields. The equation also shows more statistically significant coefficients than equation eight did, but seems to have same kind of inconsistencies with the signs of the coefficients. The initial effect of the purchases for the first months show a negative effect on the yields as the Fed would hope but the effect seems to be inconsistent when the lags move further back in time.

The coefficients also have relatively low values, suggesting under 0,1 unit change for the US treasury yields. The LRP-coefficient has an expected negative sign from the Fed's perspective, but a low value as well.

$$(9)\ dTreasury10YearYTM = \alpha + \beta_1 d\ln\sum_{t=1}^{11} TreasuriesheldbyFed_{t-1} + \beta_2 d\ln\sum_{t=15}^{18} TreasuriesheldbyFed_{t-1} + \varepsilon$$

**Table 8.** Coefficients for regression 9.

| Variable | Coefficient | std. error | t-value | p-value | | |
|---|---|---|---|---|---|---|
| const | 0,000428181 | 0,0332919 | 0,01286 | 0,9898 | | |
| ld_Alltreasurie | 7,46574 | 1,16456 | 6,411 | 3,47e-08 | *** | |
| ld_Alltreasurie_1 | −3,03365 | 1,46027 | −2,077 | 0,0424 | ** | |
| ld_Alltreasurie_3 | −5,39087 | 0,904459 | −5,960 | 1,86e-07 | *** | |
| ld_Alltreasurie_4 | 4,57281 | 2,01313 | 2,271 | 0,0271 | ** | |
| ld_Alltreasurie_5 | −1,99319 | 1,16279 | −1,714 | 0,0921 | * | |
| ld_Alltreasurie_8 | −6,90922 | 1,91201 | −3,614 | 0,0007 | *** | |
| ld_Alltreasur~_10 | 5,66163 | 1,34161 | 4,220 | 9,21e-05 | *** | |
| ld_Alltreasur~_11 | −3,57025 | 0,924263 | −3,863 | 0,0003 | *** | |
| ld_Alltreasur~_15 | 4,42662 | 0,976336 | 4,534 | 3,17e-05 | *** | |
| ld_Alltreasur~_16 | −7,47446 | 1,29462 | −5,773 | 3,73e-07 | *** | |
| ld_Alltreasur~_17 | 1,98221 | 0,886578 | 2,236 | 0,0294 | ** | |
| R-squared: | 0,531762 | Adjusted R-squared: | 0,395547 | | | LRP: -0,669 |

As mentioned before the Fed also incorporated the zero bound interest rate policy to go alongside with the QE-programs during the sample period of 2009 till 2016. The Fed wanted to promote more economic growth with the low interest rate policy through lower market interest rates, which could set the environment more favourable for borrowing, consumption and inflation. As mentioned earlier, the commitment to the zero bound policy can also be a significant factor in the success of quantitative easing. This is why it is also suitable to study the Fed Funds Rate's affects on the economy.

$$(10)\ dMBS30yearYTM = \alpha + \beta_1 \sum_{t=1}^{4} dFFR_{t-1} + \beta_2 dFFR_{10} + \varepsilon$$

**Table 9.** Coefficients for regression 10.

| Variable | Coefficient | std. error | t-value | p-value | | |
|---|---|---|---|---|---|---|
| const | −0,00517033 | 0,0262504 | −0,1970 | 0,8444 | | |
| d_FFRate_2 | −3,51319 | 1,20181 | −2,923 | 0,0046 | *** | |
| d_FFRate_10 | 4,20591 | 1,81567 | 2,316 | 0,0233 | ** | |
| R-squared: | 0,198937 | Adjusted R-squared: | 0,133096 | | | LRP: 0,670 |

(11) $dtreasury10yearYTM = \alpha + \beta_1 \sum_{t=7}^{12} dFFR_{t-1} + \varepsilon$

**Table 10.** Coefficients for regression 11.

| Variable | Coefficient | std. error | t-value | p-value | | |
|---|---|---|---|---|---|---|
| const | −0,0168392 | 0,0231446 | −0,7276 | 0,4693 | | |
| d_FFR | −1,53711 | 0,842901 | −1,824 | 0,0725 | * | |
| d_FFR_6 | −1,55855 | 0,683701 | −2,280 | 0,0257 | ** | |
| d_FFR_7 | 1,11901 | 0,635748 | 1,760 | 0,0828 | * | |
| d_FFR_8 | 2,18854 | 1,06245 | 2,060 | 0,0432 | ** | |
| d_FFR_9 | 2,42866 | 0,893228 | 2,719 | 0,0083 | *** | |
| R-squared: | 0,176563 | Adjusted R-squared: | 0,081092 | | | LRP: 1,708 |

Equations ten and eleven are conducted to see how significant factor has the Fed Funds Rate been as an explaining force behind the developments of the MBS -and US treasury yields. The R-squared coefficients in tables ten and eleven are lower for both equations than they generally were with the equations that incorporated QE as an explaining factor. Therefore the Fed Funds Rate has not been as significant factor in the developments of these particular asset classes as the asset purchases after the financial crisis. Equation ten only gathers two statistically significant coefficients, two month and ten-month lags. In order for the Fed's monetary policy easing to work effectively the signs of the variables should be the same, in other words if the Fed Funds Rate decreases, so should the asset yields too. The MBS equation ten does not give consistent proof of this according to the significant factors in table nine. The LRP-coefficient on the other hand does suggest that there is a positive correlation between the rates on the long run of 0,67 units. Equation 11 suggests that the Fed Funds Rate has had a more consistent affect on the longer run on the US treasury yields. Lags of seven, eight and nine months in table 11 all have positive signs and their coefficients are quite high. The LRP-value is also much higher than it is with the MBS-securities.

(12) $d\ln CPI = \alpha + \beta_1 \sum_{t!1}^{6} dFFR_{t-1} + \varepsilon$

**Table 11.** Coefficients for regression 12.

| Variable | Coefficient | std. error | t-value | p-value | | |
|---|---|---|---|---|---|---|
| const | 0,00140380 | 0,000254483 | 5,516 | 4,24e-07 | *** | |
| d_FFR | −0,00723994 | 0,00808446 | −0,8955 | 0,3732 | | |
| d_FFR_1 | −0,0264858 | 0,0121542 | −2,179 | 0,0323 | ** | |
| d_FFR_6 | −0,00656549 | 0,00263157 | −2,495 | 0,0147 | ** | |
| R-squared: | 0,184887 | Adjusted R-squared: | 0,112662 | | | LRP: -0,022 |

Finally equation 12 looks into the relationship between inflation (CPI) and the Fed Funds Rate. In order for the Fed's monetary policy to work accordingly, the FFR coefficients should have negative signs, since inflation tends to move in the opposite direction than interest rates. This is also true according to equation 12 during the sample period and the significant coefficients in table 11 including the LRP are negative. It seems that the first reaction to changes in the Fed Funds Rate is the most significant as the one month lagged coefficient has the highest value, meaning a one unit change in the FFR, results in a -2,65 unit change in inflation. The R-squared values remain relatively low in contrast with the values that the QE equations receive, and it is therefore probable that many other aspects within the economy affect inflation as well.

## 4.5. VAR-model results

The VAR-models are conducted in support of the regression analysis. The separate VAR-models' impulse responses are described in figure seven and each of the figures are derived from the same data samples that were used in the corresponding regression models. The numbers of the impulse responses correspond with the number of the regression equation they are derived from. The VAR-models are used to illustrate what would happen to the dependent variable in the regression models, if an unexpected shock of one standard error were to occur in the independent variable. This concerns the time line where the sample data was taken from but the VAR-model also indicates the variables relationship for the future. This can be valuable for the examination of the Fed's monetary policy after the financial crisis, because as can be seen from figure five, the low interest rate policy and the QE asset purchases are still in affect in the Fed's monetary policy. All the VAR-figures are illustrating a time span of 24 months.

The clearest initial reactions according to the VAR-models are resulted for inflation, mortgage rates and consumption. The initial positive shock in monetary base results in a clear spike in inflation according to the first VAR-model. The effect seems to be very minor nevertheless; only little above 0,001 per cent affect, and the initial response fades out during the first 12 months and starts to flatten when the timeline moves further. The first reaction in mortgage rates to a shock in monetary base turns out to be exactly opposite to what the Fed would hope, as the first response results in a minor increase in mortgage rates. It takes up to around six months for the first shock to clear out before the response switches to negative territory. All together a shock in monetary base does not create a significant response in the mortgage rates judging by the coefficients' val-

ues. On the other hand a shock in the monetary base seems to have a more desirable effect for consumption from the central bank's perspective. The first 12-month period includes two clear positive spikes and the impulse response stays as positive most of the time during the first year. With consumption the coefficients receive quite low coefficient values however. For instance the largest impulse response, which is the initial first positive spike only suggests a 0,005 per cent increase in consumption if a shock occurs in the monetary base.

The impulse responses of the MBS –and US treasury yields seem to show quite similar results as their regression models did. A shock in the amounts of MBS-securities under the Fed's balance sheet seem to cause high variance in the MBS-yields during the first 12 months, but the positive and negative reactions seem to cancel each other out as the time line advances. The reaction in the 10-year US treasury yields seems to give a stronger trend line during the first year and indeed suggest the reaction in the treasury yields to be negative, as the Fed would hope. After the first year the impulse response still shows signs of a negative effects on the treasury yields and the overall response seems to be negative. In both, MBS and US treasury VAR-models, the coefficient values stay relatively low. In MBSs the shock variance stays between 0,0003 and -0,0003 unit effect and between 0,0005 and -0,0005 with the US treasuries.

As the VAR-results concerning the mortgage rate developments, the impulse responses for housing prices and new home sales do not give consistent results to support the Fed's goals for its quantitative easing programs. The initial responses for a shock in monetary base do signal a slight positive reaction, but this reaction is reversed in under five months in both cases. In the house price VAR-model the positive reaction peaks at 0,0007 per cent change and at 0,01 per cent with the new home sales. In housing prices the downward response trend starts at five month and end at ten-month point, where it starts to rise up once again. The first five months of the new home sales VAR include a downward spike reaching 0,025 per cent and after that the impulse response fluctuates around zero for the rest of the examination period.

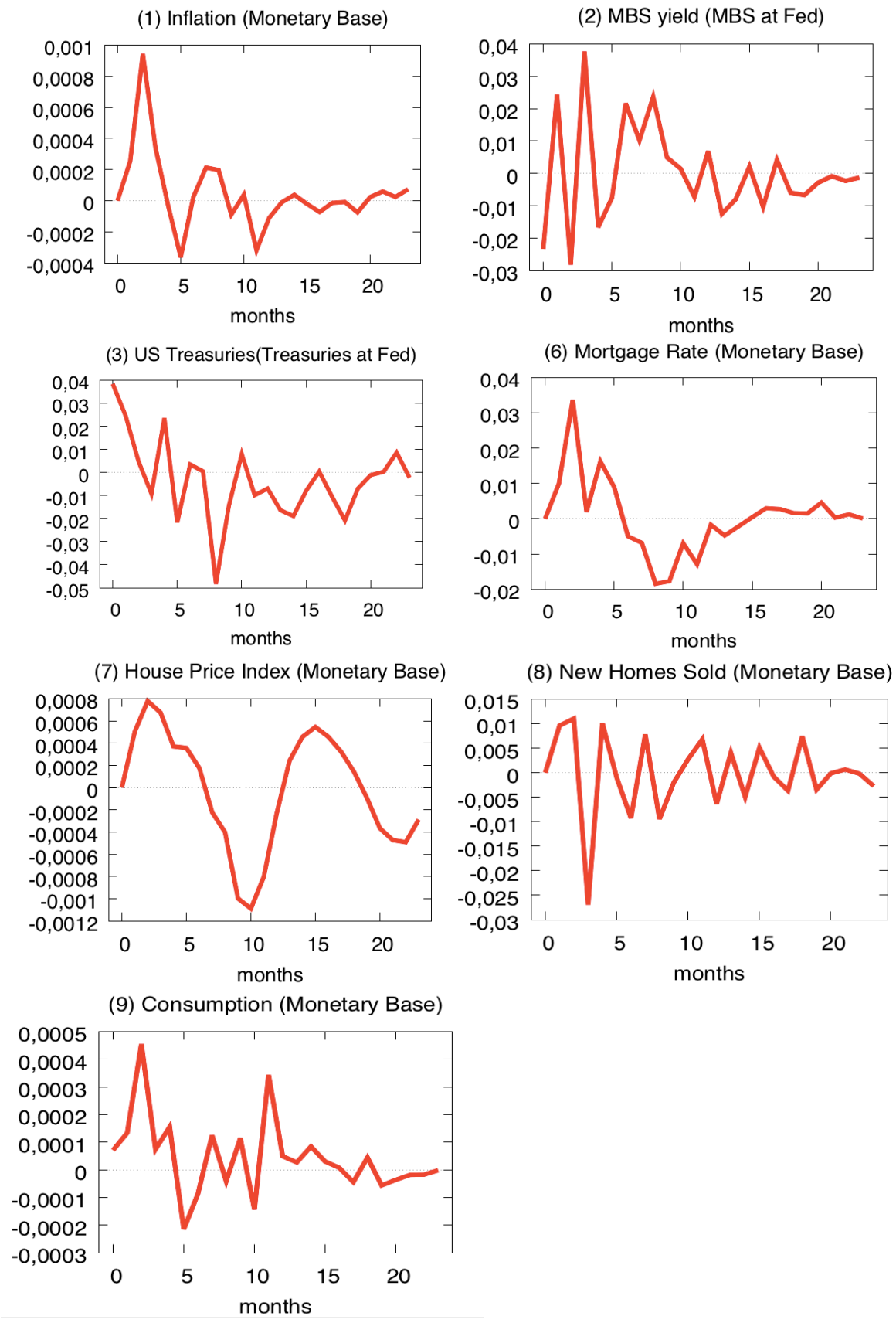


**Figure 7.** VAR-models' impulse responses

# 6. Results analysis and discussion

This chapter is dedicated for analysing and discussing the results from the different regression analyses and the VAR-models that were presented in the previous subchapters. Because the Fed's quantitative easing program and the zero bound interest rate policy was something that had never been seen in the US monetary policy, it is important to evaluate how effective the policies have been according to the results in contrast with the objectives the central bank has presented.

## 5.1. MBSs and US treasury bonds

With the MBS –and US Treasury bond purchases the Fed was directly aiming to affect the pricing of these securities on the markets. This would be achieved if the Fed were to be successful enough in adjusting their supply and demand balance on the markets and affecting the securities' yield levels. (Board of Governors (2008b); (2010); (2011) & Bernanke (2012)). The results of regression model eight and nine do show evidence that the MBS –and treasury purchases have explained a significant amount of the fluctuations in the 30-year MBS-security and US treasury yields over the sample period of 2009 till 2016. However the results do not give strong proof that the effects of the purchases have been consistently driving the yields towards lower levels. The LRP-coefficient for the US treasuries is negative as the Fed would hope, but for MBSs it is positive. Many other factors affect the MBS-yields in the markets and since the sample period is quite long also, raising concerns about the MBS coefficient's sign is not straightforward but it still raises distress about the MBS-purchases effectiveness on the securities yields over the long run. Figure eight illustrates the real developments of the MBS and US Treasury yields during the sample period. Figure eight indeed shows that the overall trend in the yields has been downward sloping, but as the regression and VAR-results suggested, there has been a lot of variance and inconsistencies in the developments of the yields. As can be seen in figure eight, the treasury yields has approximately dropped by two per cent from the beginning of the sample period from 2009 till 2016, whereas the MBS yields have only moved down by one per cent. In other words the treasury yields have dropped by ten per cent more than MBSs.

Since the regression that studied the treasury yields gave a higher R-squared results and more consistent VAR results with a hoped sign for the LRP-coefficient as well, it can be

valid to say that the response of the Fed's actions on treasury yields have been more efficient than on the MBSs. This can be due to the fact that the markets for US treasuries are much larger and more liquid, which can promote more effective responses over short and long term periods. On the other hand the results did show many inconsistencies in the effects of the asset purchases. Figure eight also shows that the red and blue yield lines have fluctuated quite a lot during the sample period. The variance of the lines has been especially strong during the first years of the QE-programs. What can be seen noteworthy in figure eight is that there have been quite a lot of movements in the yield trends already before the announcements of the QE2 and QE3 –programs, which occurred in late 2010 and 2011. The earlier discussion about how investors' expectations affect the yield curves significantly might offer some explanation for these movements. Even though the Fed makes official announcements of its monetary policy in official press releases, it does discuss its policy conduct regularly in the press through many different channels and the markets try to interpret all available information quickly and make forecasts on the Fed's policy beforehand already. This might explain why the yield levels have already dropped before the announcements of QE2 and QE3, which happened in late 2010 and 2011.

What might be concerning according to the regression results and what can be seen in figure eight are the upward swings in the yields after the announcements and initiations of QE2 and QE3 –programs. Wright (2012) suggests that the quick reversal in the yields could have happened either due to a quick recovery in the economical factors the Fed wanted to influence, or because the initial drop in the yields was exaggerated. The results of this study did not show any evidence to support quick recovering effects for the US economy due to the QE or zero bound interest rate policies. Chung (2011) and Krishnamurthy and Vissing-Jorgensen (2011) have studied the short-term effects of the QE announcements and also suggest very minimal affects for the programs on the short-term. In other words it could very well be possible that some over reactions have occurred in the MBS and treasury markets around the announcements of the QE-programs. Since the QE-programs were very large and unseen actions by the central bank, large and possible overreactions are not completely irrational phenomena, since the markets did not have many benchmarks to compare the possible outcomes of the QE programs to beforehand. When the Fed announced the initiation of the QE3-program in late 2011, the markets did already have some comparable data in use from the previous programs, and indeed the market fluctuations have not been as steep during the first year of the QE3-program.

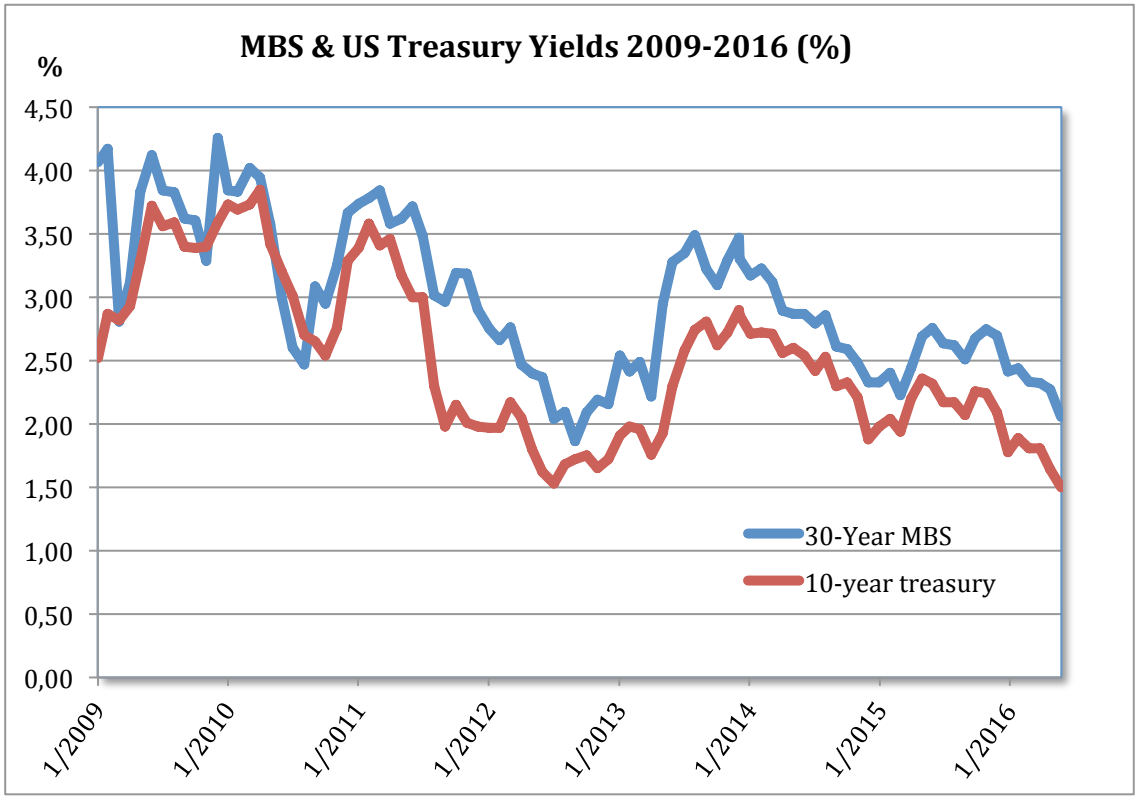


**Figure 8.** 30-year MBS & US Treasury Yields-to-maturity during 2009 and 2016

## 5.2. Housing markets

Tables four through six illustrate the results for the regressions that studied the Fed's QE programs' effects on the housing markets. The Fed especially emphasized three aspects about the markets, which it wanted to influence and these were the average mortgage rates, new home sales and the general house prices. Considering the results for the developments of mortgage rates, the QE programs do not seem to have explained a significant proportion of the rate movements and the coefficients do not have expected negative signs. This might be concerning considering the Fed's intentions to promote growth for the mortgage markets. Figure nine gives some support for this finding since it can be seen that the green line illustrating the development of the mortgage rate during the sample period has been quite slow during the first years of the QE-programs, and has started to decrease more strongly not until two years after QE1.

The results for the general house price index in table five indicate a same type of small short-term effect of QE for housing prices, since the coefficients tend to have quite small but positive values. The fact that the coefficient values turn into to negative terri-

tory in the six and seven month lags might be concerning for the central bank's policy's credibility since they suggest that in half a year QE tends to have negative effects for the development of the house price index. This conclusion might find some support from figure nine. As can be seen the red line for house price index actually stays on a negative trend all the way up until 2013 and tends to have modest up -and downward fluctuations in it. It could be therefore said that the QE-programs have not been very effective in supporting the housing markets' development especially in the first four years of the program. However the overall market environment in the first years of the asset purchasing programs was challenging and therefore a sudden and strong upward trend might not be an outcome that is justified to expect.

Williamson (2015) also offers another possibility for the slow movements in the mortgage rate and housing price developments. Williamson discusses the practical regime of how the excess cash that QE is supposed to channel to the markets might not have been working properly during the QE-programs. Bernanke (2012) describes how the natural idea of the QE programs is not to simply print money and inject it to the markets. He points out that when the Fed purchases assets, it pays for them by injecting more cash onto the private banks' reserves accounts at their own central bank reserve accounts. Therefore according to Bernanke the Fed is simply creating more central bank reserves and not creating more currency. Williamson challenges this view by pointing out that if the excess reserves created through QE simply sit on the reserve accounts and are not put into use by the private banks, the asset purchases might not have any affect for the economy at all. Considering that the financial markets were suffering from a volatile period of the recession and uncertainty especially in the early years of the QE-programs, Williamson's argument might have some merit. It may have indeed been that even though excess reserves were created for the private banking sector, the banks might have been quite reluctant to increase their lending for the weak housing markets and increase their risk levels by lowering their rates in mortgage lending.

Williamson's claims and the weak overall market environment during the early years of the QE-programs might explain why it took so long for the markets of new home sales to pick up as well. Figure nine shows that the early years of the QE-programs have been quite volatile in the new home sales markets and only in 2012 the number of new homes sold has exceeded the amount of the comparison month's sales and moved into a stronger growth path. As can be seen from table six the first month lag does have a positive sign and suggests more than one per cent rise in new home sales when the monetary base grows by one per cent. This could implicate a positive reaction in the eyes of the Fed, but the other significant coefficients have negative signs and show a reversing ef-

fect for QE. This can also be seen in figure nine in the highly volatile first years of the new home markets, illustrated by the blue line. While the R-squared values remain quite low for table six, and the VAR-model figure shows no conclusive results, it may be granted to say that QE has not indeed been significant enough during the first years of the recession to promote better markets for new home sales.

Looking into the VAR-results more closely, more conclusions on the possible weak connection of the QE-programs and the housing markets can be drawn. For instance the figure for the mortgage rate impulse response shows an initial positive shock in mortgage rates for a positive shock in money supply. This is not what the Fed would hope but may be rational when considering that the mortgage markets were indeed one of the main sources for the whole financial crisis. The overall weakness in the mortgage markets may have been a too large of a risk for the banking sector to react to the QE by lowering their mortgage lending rates, which may explain the long lag for the rates to come down. On the other hand the VAR-model for the house price index might suggest that the markets were not drawing consistent conclusions when the Fed was adding more QE-injections during the years of the monetary easing. Yu (2016) mentions that even though the first asset purchases might have been received well in the markets, the positive expectations for the future and for the effectiveness of the QE-programs might have worn off when the markets were struggling for so many years and the central bank had to initiate many new rounds of asset purchase programs.

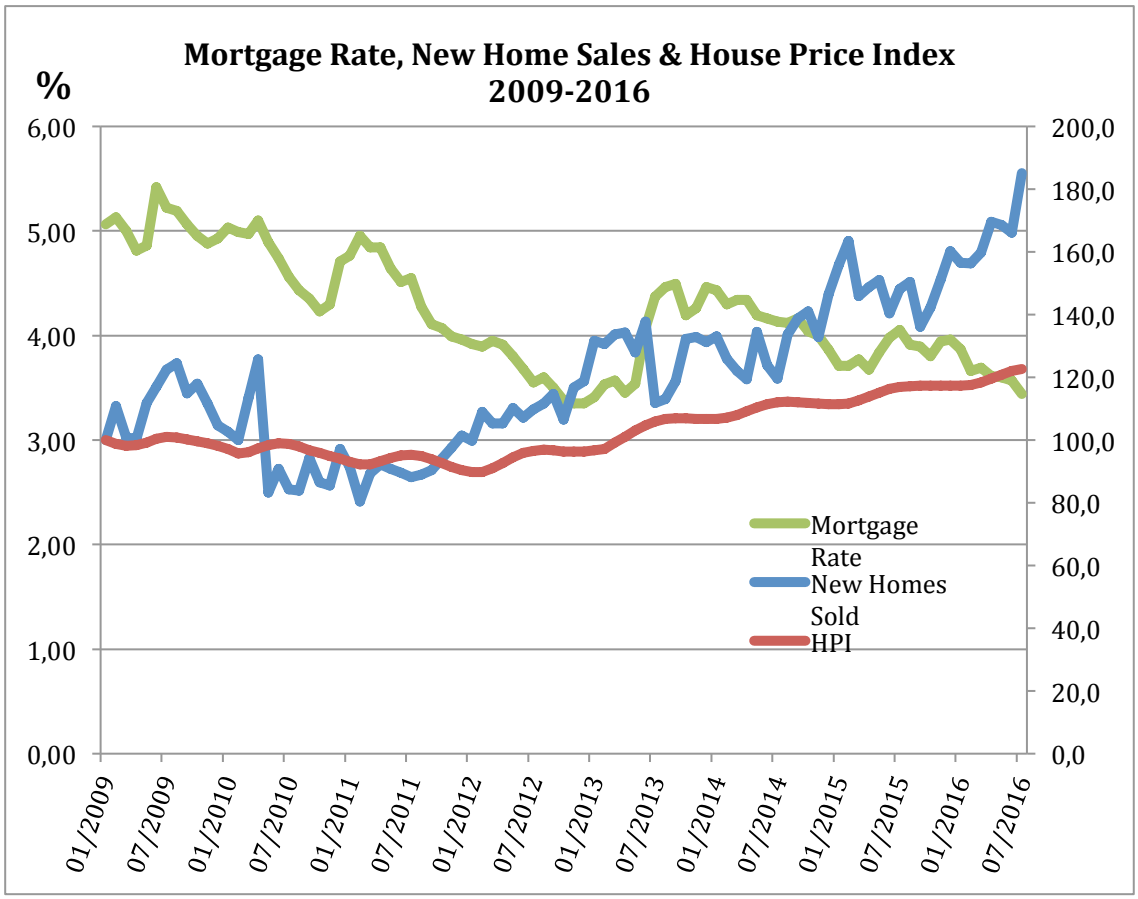


**Figure 9.** US average mortgage rate (left), new home sales and S&P/Case-Schiller national home price index (right)

## 5.3. Inflation, consumption and credit markets

During the sample period of this study, inflation has tended to feature in all of the press releases that the Fed has reported alongside the reports of the quantitative easing programs. The Fed has repeatedly informed that promoting higher and steadier inflation growth has been one of its key targets to reach with its unconventional monetary policy after the financial crisis. Promoting a steady inflation level of two per cent is included in the Fed's duel mandate alongside with maximum employment so it is not surprising that inflation was one of the key factors to influence since the bursting of the financial crisis caused the inflation rate to plummet down to minus two per cent in the midst of the crisis as can be seen in figure ten. Considering that the Fed aims to maintain the inflation of the US economy on steady levels, figure ten shows that this has been a challenge since a lot of variance can be seen in the blue line representing the change in the con-

sumer price index. Considering that this high variance in the inflation rate has existed during the sample period of 2009 till 2016, it is not necessarily surprising that the results of this study do not give conclusive results for the Fed's unconventional monetary policy's influence to the inflation rate.

The results found in table one for the regression studying the connection between the QE-programs and inflation did not give expected nor high signs for the coefficients that would give proof for a strong relationship between the size of the monetary base and the inflation rate. Coefficients in regression 12 on the other hand gave higher values and indicated an expected inverse relationship between the Fed Funds Rate and the inflation rate. The overall coefficient for the regression implied a 0,7 per cent rise in inflation if the Fed Funds Rate were to decline by one unit. The one-month lag coefficient gave an even higher effect of a two per cent reaction for the inflation rate. Coefficient wise it seems that a stronger relationship would have existed between the main directing interest rate and inflation than with the monetary base. The R-squared coefficients remained much lower however with the Fed Funds Rate regression than with the monetary base equation. The results imply that the monetary base explained around 30 per cent of the variance in inflation while the Fed Funds Rate only explained fewer than 20 per cent of the variance. All together it can be concluded that even though the results give some evidence that the Fed Funds Rate may have had an impact on the fluctuations in the inflation rate, the low R-squared values in both regressions and the high variant inflation trend in figure ten would suggest that other economical factors may have been driving the developments of the inflation rate in a stronger manner after the financial crisis.

Analysis of the results for the regression three studying the connection between monetary base and the amount of total credit lent out by the private banking sector in the US might show some merit once more for Willamson's (2015) argument about the unused assets on the banks' reserve accounts. While the purpose of the QE programs was to enable banks to lend out more loans for the private sector as more liquidity would be freed when the central bank makes asset purchases from the banks, lending activity has not seemed to respond as positively as the central bank probably would have hoped. As can be seen in figure ten, the total amount of credit lent out in the US either decreased or only grew under two per cent up until the beginning of 2012. In other words it took three years either for the QE-programs to start promoting more steady lending activity or again the QE-programs have not succeeded in being a sufficient force driving the credit markets to higher levels.

Table two could provide proof for the latter explanation to be more accurate. While the R-squared values suggest that the monetary base has explained around 40 per cent of the variance in the amount of credit in the US during the sample period, the coefficient values imply that there has actually been a negative correlation between the two factors. This could mean that even though the banks have received more liquidity from the Fed through the asset purchases the banks have not channelled this forward as new loans for the private sector. Whether this is due to a lack in demand for new loans from the private sector or a reluctance of the banks to offer new loans, this could also bring some explanation to the poor results that were found for the connection of QE and inflation. After all for the QE to promote higher levels of inflation, the excess cash and liquidity needs to transfer through to the financial system for households and businesses to promote higher consumption and investment activity. Williamson (2015) stated that if the excess liquidity generated through QE just means cash sitting on the reserve accounts at the central bank, QE might not generate any growth in the factors the Fed would want to promote.

Lastly figure ten shows that consumption seems to have picked up much faster from its lowest levels after the crisis than the amount of credit has. Even though the Fed has informed precisely that promoting more credit was a key way to accelerate more consumption and more inflation, the amount of credit seems to have been the lagging factor out of these three. Table three gives no conclusive explanation that QE would have been responsible for the growth in consumption no more than the amount of credit. The equation four gives out a negative coefficient for the monetary base variable suggesting a negative relationship between a growth in monetary base and consumption and the R-squared values remain quite low. While the initial impulse response in the consumption VAR-model seems to result in a positive spike for a short period, the response tends to remain on a very moderate level as well. Hence worth it seems that neither QE nor the amount of credit have been the driving forces behind the developments of consumption in the US.

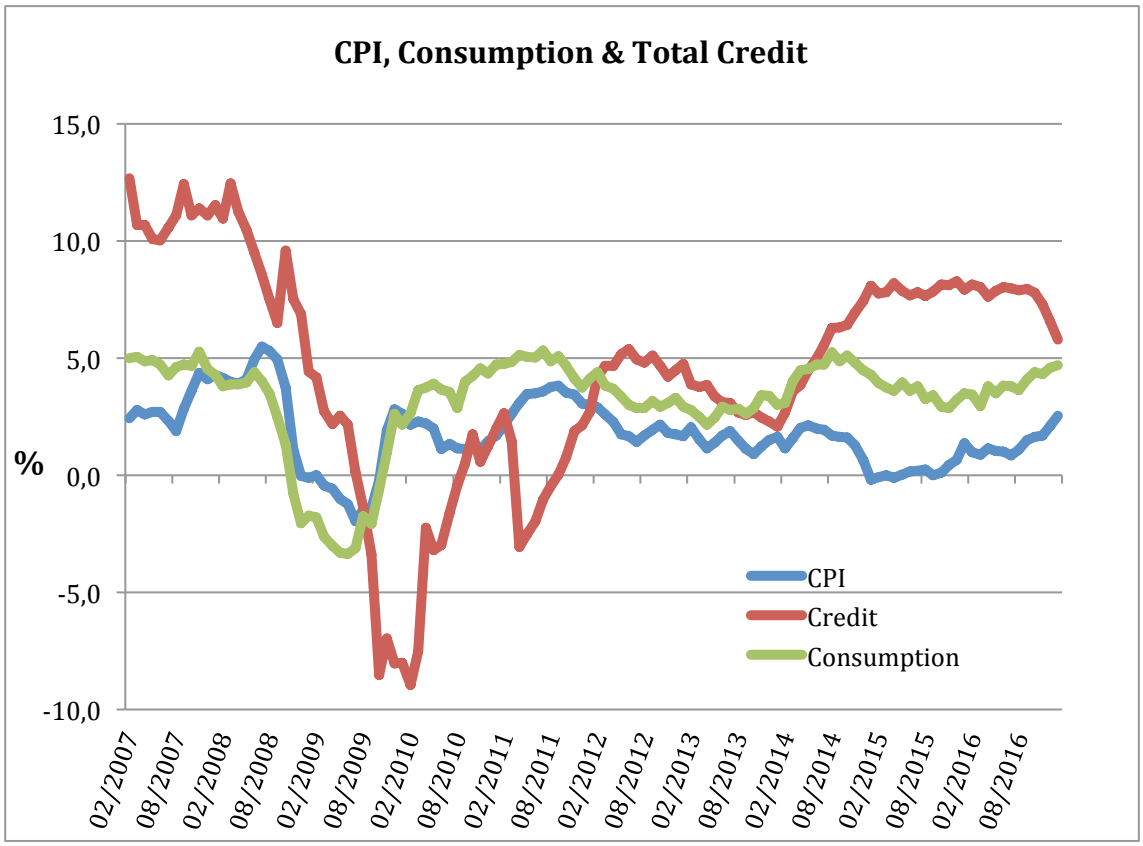


**Figure 10.** Consumer price index, personal consumption and total bank credit in the US, per cent changes from previous year

# 7. Conclusions

The financial crisis proved to be a challenge for the Federal Reserve that its conventional monetary tools were not sufficient to solve. In order to solve the credit crunch in the financial sector and avoid a complete systemic failure of the economy, the central bank started adjusting its monetary policy regime aggressively. Quantitative easing and zero bound interest rate policies were initiated and continued for many years also to promote better environment for consumption, inflation, real estate and securities markets. Given that the time of unconventional monetary policy has lasted for so many years in the US, and considering the benchmark experiences of Japan's and Eurozone's unconventional monetary policies, the results of this study showing weak overall connections between QE and zero bound interest rate policies and better economic recovery are perhaps not that surprising.

According to the results of this study, the US securities and MBS yields seemed to have the strongest reactions for the asset purchases and the zero interest rate policy but the findings still did not provide a hoped consistent trend change in the securities yields that the Fed would have hoped for. Considering the developments in the housing markets after the financial crisis, the results imply a high possibility for the fact that other economical factors have dominated over the monetary policy actions during the first years after the crisis. The results for an expected inverse relationship between mortgage rates and QE were weak, and the rates for mortgage loans do not seem to have responded quickly enough and have not decreased sufficiently to promote recovery for new home sales or a general rise in house prices.

The results that were achieved for the responses of credit levels in contrast with the expansion in the monetary base may actually offer one of the most valuable implications for the overall results of this study. Given that promoting higher levels of credit was one of the key goals for the Fed to achieve with the QE –and zero bound interest rate policies, the fact that the results actually offer a negative correlation between an expansion in monetary base and levels of credit can be high of significance. Since the coefficients for the monetary base in the short –and long term were negative but while the R-squared values were quite high, the argument for poor credit transferring effect can be made. In practice this means that it may very well be true that the private banking sector has not acted in the way the central bank has hoped for, and the banks have not created enough of new excess credit especially in the first years following the crisis. If the excess reserves have been sitting on the reserve accounts as Williamson (2015) and Bernanke

(2012) have said, the lacking credit expansion could have prevented a consistent increase in consumption, inflation and housing market activity.

Considering that the overall objective of this study was to evaluate the effectiveness of the Fed's unconventional monetary policy after the financial crisis, the results that showed weak responses for QE and zero bound interest rates policies can offer very valuable information for the future use of such policy regimes. Given that this was the first time that the Federal Reserve initiated these sorts of policies, the most efficient execution can not be expected to be easy or simple and the results of this study's sample period's economic recovery are a valuable lesson for the future recessions to come. All together it seems that QE-policies can be justified and effective for adjusting weak environments in bond -and other securities markets, other structural issues within an economy may be too dominant forces during recessions and neither QE or low interest rate policies may be enough to ensure a swift recovery in inflation, credit or housing.

For future monetary policy regime it is also noteworthy to assess the risks associated with the unconventional policies that were practised after the financial crisis. Even though an economy might not recover as quickly as policy makers would hope after a recession as seemed to happen after the financial crisis, continuing extremely easy monetary policy conduct can actually create more risks than solutions with it. If the problems in economic growth are structural and not effectively responsive to monetary policy adjustments as suggested by the results of this study, a central bank may put itself in a vulnerable position if it continues to practice the types of levels of easy monetary policy for seven years or more as was seen in the sample period of this study. If a new economic shock or a recession were to strike while the monetary policy regime is already near its most easy levels, the central bank would have little room to ease its policies any more, and the end results could be dangerous. In addition keeping directing interest rates at zero for many years can mean that different asset markets such as equities and bonds may begin to form valuation bubbles, which could drive the economy back into recession as has happened many times in the US before. For instance a stock market crash in zero interest rate environment would mean that investors would simultaneously loose their asset values from equities, but would not have any protection from fixed income assets, since bond yields would be at low levels already as well.

In summary this study's concluding remarks are that QE and zero interest rates can be justified responses for extreme levels of systemic economical shocks, but an extended period of their usage for many years and the economical factors that are reported as the policy's targets should be considered in the future. In addition it should be said that fu-

ture research of the Fed's unconventional monetary policy is still needed after the central bank has managed to reverse all of its QE actions by shrinking down its balance sheet from the assets it has acquired during the programs and after the Fed Funds Rate has returned on its long-term average levels. Only then it can be concluded whether a long period of easy monetary policy did not cause too large undesired phenomena in the economy after the programs were reversed. If however the Fed were to have problems in shrinking its balance sheet or raising the Fed Funds Rate, it is crucial to study why that was so that overall judgements about unconventional monetary policy actions can be concluded.

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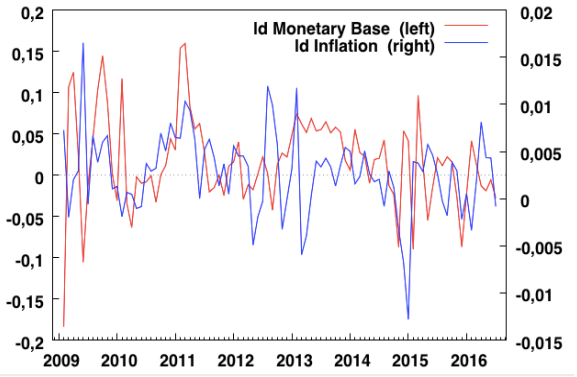
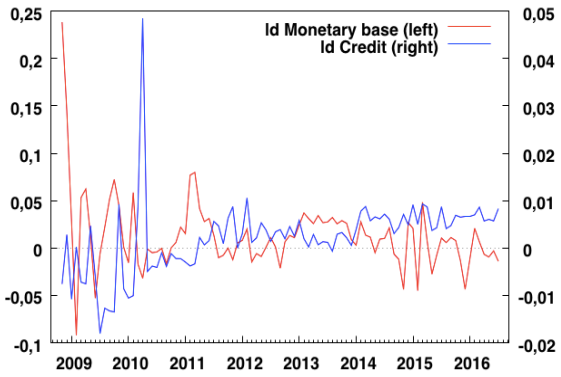
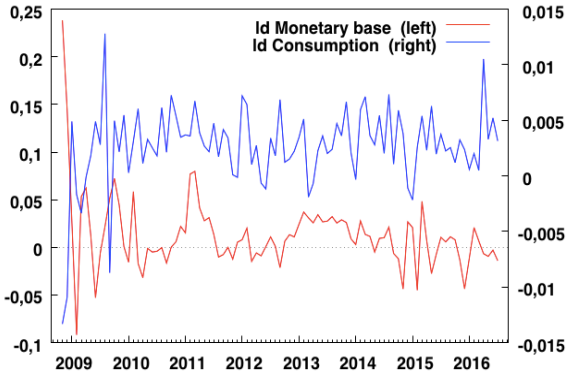
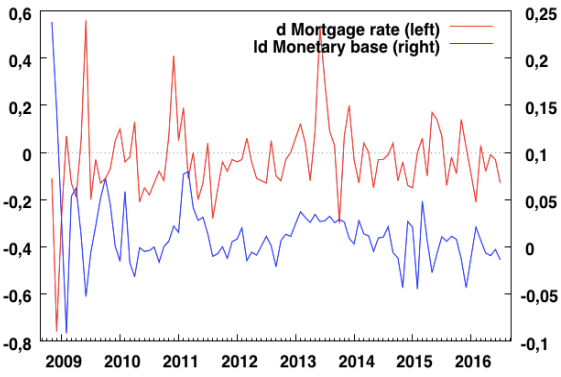
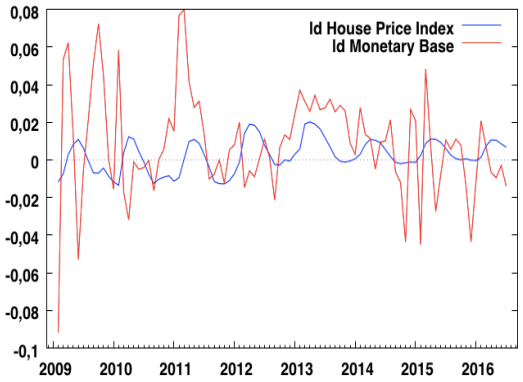
**Appendix 1.** Data time series'

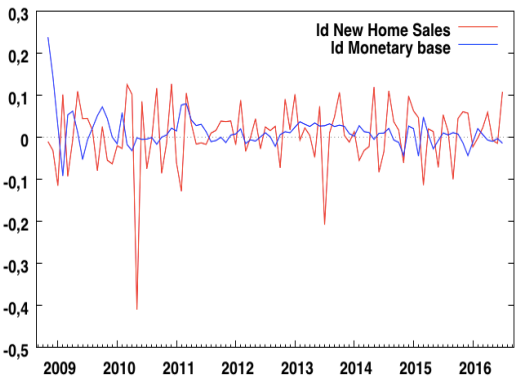


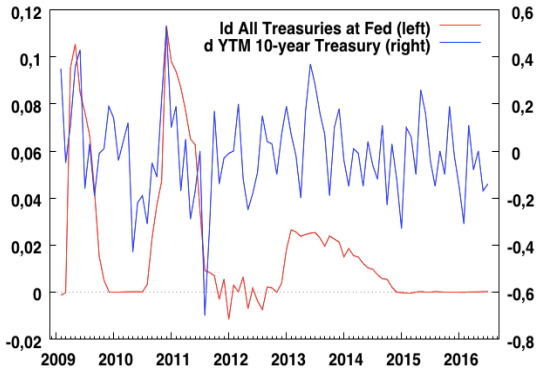



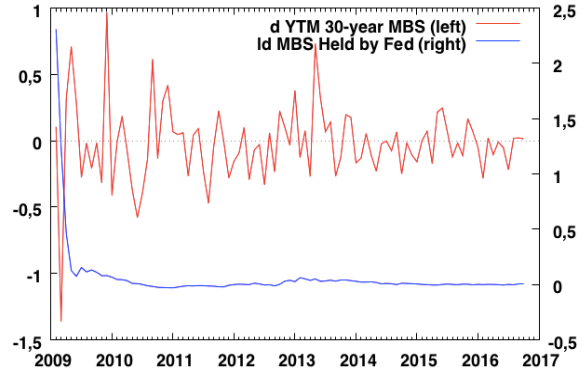



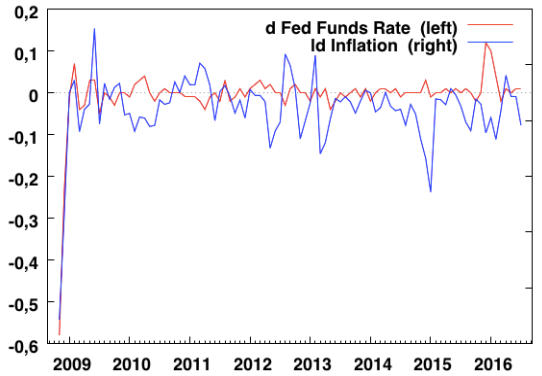



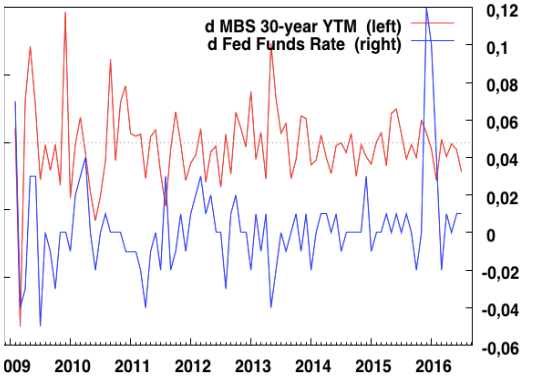



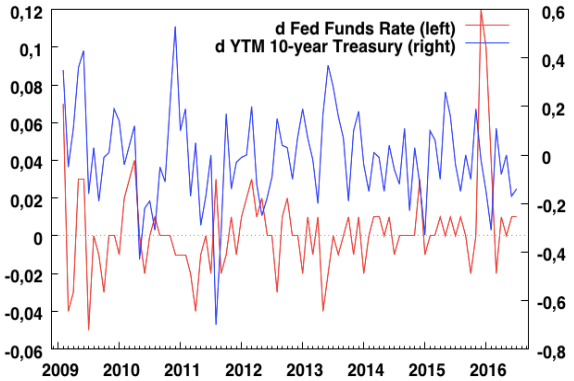




ld All Treasuries at Fed (left)
d YTM 10-year Treasury (right)
0,12
0,1
0,08
0,06
0,04
0,02
0
-0,02
0,6
0,4
0,2
0
-0,2
-0,4
-0,6
-0,8
2009
2010
2011
2012
2013
2014
2015
2016


d YTM 30-year MBS (left)
ld MBS Held by Fed (right)
1
0,5
0
-0,5
-1
-1,5
2,5
2
1,5
1
0,5
0
-0,5
2009
2010
2011
2012
2013
2014
2015
2016
2017


d Fed Funds Rate (left)
ld Inflation (right)
0,2
0,1
0
-0,1
-0,2
-0,3
-0,4
-0,5
-0,6
0,01
0,005
0
-0,005
-0,01
-0,015
-0,02
2009
2010
2011
2012
2013
2014
2015
2016


d MBS 30-year YTM (left)
d Fed Funds Rate (right)
0,12
0,1
0,08
0,06
0,04
0,02
0
-0,02
-0,04
-0,06
009
2010
2011
2012
2013
2014
2015
2016


d Fed Funds Rate (left)
d YTM 10-year Treasury (right)
0,12
0,1
0,08
0,06
0,04
0,02
0
-0,02
-0,04
-0,06
0,6
0,4
0,2
0
-0,2
-0,4
-0,6
-0,8
2009
2010
2011
2012
2013
2014
2015
2016

**Appendix 2.** Regression and VAR-model data

| Date | Monetary base | Fed Funds Rate | 10-year US Treasury yield | 30-year MBS yield | CPI (inflation) | Treasuries at Fed | MBS held by Fed | Home Price Index | Mortgage Rate | New Homes Sold | Total Credit | Consumption |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01/01/2009 | 1712014 | 0,15 | 2,52 | 4,07 | 211,9 | 475421 | 6751 | 149,38 | 5,06 | 100,0 | 7178,5 | 9792,1 |
| 01/02/2009 | 1561699 | 0,22 | 2,87 | 4,17 | 212,7 | 474813 | 67975 | 147,64 | 5,13 | 110,7 | 7180,1 | 9775,7 |
| 01/03/2009 | 1647305 | 0,18 | 2,82 | 2,81 | 212,5 | 474683 | 236483 | 146,54 | 5,00 | 100,9 | 7128,6 | 9742,9 |
| 01/04/2009 | 1753246 | 0,15 | 2,93 | 3,12 | 212,7 | 522172 | 377349 | 146,97 | 4,81 | 100,3 | 7074,9 | 9741,9 |
| 01/05/2009 | 1775104 | 0,18 | 3,29 | 3,83 | 213,0 | 580276 | 428521 | 148,19 | 4,86 | 111,9 | 7108,1 | 9759,7 |
| 01/06/2009 | 1683704 | 0,21 | 3,72 | 4,12 | 214,8 | 631680 | 462021 | 149,82 | 5,42 | 117,0 | 7064,8 | 9807,6 |
| 01/07/2009 | 1673598 | 0,16 | 3,56 | 3,84 | 214,7 | 681897 | 539414 | 150,77 | 5,22 | 122,3 | 6938,5 | 9835,2 |
| 01/08/2009 | 1710773 | 0,16 | 3,59 | 3,83 | 215,4 | 728817 | 605162 | 150,69 | 5,19 | 124,4 | 6850,9 | 9961,9 |
| 01/09/2009 | 1801165 | 0,15 | 3,40 | 3,62 | 215,9 | 761042 | 690826 | 149,65 | 5,06 | 114,9 | 6760,6 | 9875,4 |
| 01/10/2009 | 1936314 | 0,12 | 3,39 | 3,61 | 216,5 | 772673 | 772080 | 148,60 | 4,95 | 117,9 | 6670,0 | 9924,6 |
| 01/11/2009 | 2024608 | 0,12 | 3,40 | 3,29 | 217,2 | 776524 | 836245 | 147,96 | 4,88 | 111,6 | 6731,8 | 9946,1 |
| 01/12/2009 | 2026220 | 0,12 | 3,59 | 4,26 | 217,3 | 776565 | 907165 | 146,69 | 4,93 | 104,8 | 6674,1 | 10000,6 |
| 01/01/2010 | 1994962 | 0,11 | 3,73 | 3,84 | 217,5 | 776607 | 969887 | 145,00 | 5,03 | 102,7 | 6603,9 | 10003,4 |
| 01/02/2010 | 2115182 | 0,13 | 3,69 | 3,84 | 217,3 | 776582 | 1015449 | 143,06 | 4,99 | 100,0 | 6537,9 | 10034,7 |
| 01/03/2010 | 2079591 | 0,16 | 3,73 | 4,02 | 217,4 | 776629 | 1061369 | 143,60 | 4,97 | 113,4 | 6595,3 | 10095,5 |
| 01/04/2010 | 2014449 | 0,20 | 3,85 | 3,94 | 217,4 | 776713 | 1099409 | 145,39 | 5,10 | 125,6 | 6922,9 | 10106,9 |
| 01/05/2010 | 2012331 | 0,20 | 3,42 | 3,58 | 217,3 | 776813 | 1111091 | 147,02 | 4,89 | 83,3 | 6888,9 | 10140,2 |
| 01/06/2010 | 2002433 | 0,18 | 3,20 | 3,00 | 217,2 | 776951 | 1121270 | 147,69 | 4,74 | 90,8 | 6862,7 | 10165,9 |
| 01/07/2010 | 1994298 | 0,18 | 3,01 | 2,60 | 217,6 | 777009 | 1122090 | 147,54 | 4,56 | 84,2 | 6834,6 | 10184,3 |
| 01/08/2010 | 1993664 | 0,19 | 2,70 | 2,47 | 217,9 | 779519 | 1109703 | 146,40 | 4,43 | 83,9 | 6827,9 | 10247,1 |
| 01/09/2010 | 1961226 | 0,19 | 2,65 | 3,08 | 218,3 | 797520 | 1091454 | 144,59 | 4,35 | 94,3 | 6801,4 | 10268,9 |
| 01/10/2010 | 1961720 | 0,19 | 2,54 | 2,95 | 219,0 | 827549 | 1064981 | 143,12 | 4,23 | 86,6 | 6793,3 | 10343,7 |
| 01/11/2010 | 1973139 | 0,19 | 2,76 | 3,25 | 219,6 | 867476 | 1037443 | 141,82 | 4,30 | 85,4 | 6778,3 | 10399,8 |
| 01/12/2010 | 2017000 | 0,18 | 3,29 | 3,67 | 220,5 | 971591 | 1008010 | 140,63 | 4,71 | 97,0 | 6763,2 | 10436,1 |

| Date | Monetary base | Fed Funds Rate | 10-year US Treasury yield | 30-year MBS yield | CPI (inflation) | Treasuries at Fed | MBS held by Fed | Home Price Index | Mortgage Rate | New Homes Sold | Total Credit | Consumption |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01/01/2011 | 2047917 | 0,17 | 3,39 | 3,74 | 221,2 | 1071768 | 978919 | 139,05 | 4,76 | 91,4 | 6743,2 | 10474,7 |
| 01/02/2011 | 2211605 | 0,16 | 3,58 | 3,78 | 221,9 | 1177255 | 957664 | 137,74 | 4,95 | 80,4 | 6717,8 | 10512,4 |
| 01/03/2011 | 2395330 | 0,14 | 3,41 | 3,85 | 223,0 | 1284279 | 943510 | 137,79 | 4,84 | 89,3 | 6695,4 | 10583,5 |
| 01/04/2011 | 2496574 | 0,10 | 3,46 | 3,58 | 224,1 | 1387216 | 933639 | 139,15 | 4,84 | 92,3 | 6710,4 | 10624,6 |
| 01/05/2011 | 2567185 | 0,09 | 3,17 | 3,62 | 224,8 | 1480639 | 922667 | 140,68 | 4,64 | 90,8 | 6714,9 | 10653,1 |
| 01/06/2011 | 2648548 | 0,09 | 3,00 | 3,72 | 224,8 | 1576372 | 913886 | 141,93 | 4,51 | 89,6 | 6725,5 | 10676,4 |
| 01/07/2011 | 2684801 | 0,07 | 3,00 | 3,49 | 225,4 | 1631796 | 904794 | 142,33 | 4,55 | 88,1 | 6763,4 | 10727,1 |
| 01/08/2011 | 2657678 | 0,10 | 2,30 | 3,01 | 226,1 | 1646769 | 892887 | 141,78 | 4,27 | 89,0 | 6795,1 | 10745,6 |
| 01/09/2011 | 2637680 | 0,08 | 1,98 | 2,97 | 226,6 | 1660580 | 880004 | 140,16 | 4,11 | 90,5 | 6801,4 | 10790,6 |
| 01/10/2011 | 2637757 | 0,07 | 2,15 | 3,19 | 226,8 | 1672205 | 863276 | 138,40 | 4,07 | 94,0 | 6844,4 | 10827,6 |
| 01/11/2011 | 2605420 | 0,08 | 2,01 | 3,19 | 227,2 | 1666995 | 845525 | 136,65 | 3,99 | 97,6 | 6904,6 | 10828,7 |
| 01/12/2011 | 2619586 | 0,07 | 1,98 | 2,91 | 227,2 | 1676213 | 840240 | 135,16 | 3,96 | 101,5 | 6904,5 | 10827,3 |
| 01/01/2012 | 2640764 | 0,08 | 1,97 | 2,75 | 227,9 | 1656829 | 840267 | 134,17 | 3,92 | 99,7 | 6925,3 | 10905,6 |
| 01/02/2012 | 2694422 | 0,10 | 1,97 | 2,66 | 228,4 | 1661681 | 843224 | 134,01 | 3,89 | 108,9 | 6998,9 | 10975,9 |
| 01/03/2012 | 2655219 | 0,13 | 2,17 | 2,76 | 228,9 | 1661861 | 844705 | 135,89 | 3,95 | 105,4 | 7007,3 | 10987,2 |
| 01/04/2012 | 2639850 | 0,14 | 2,05 | 2,47 | 229,3 | 1672593 | 844186 | 138,50 | 3,91 | 105,4 | 7022,4 | 11017,4 |
| 01/05/2012 | 2616477 | 0,16 | 1,80 | 2,40 | 228,7 | 1660772 | 854716 | 141,08 | 3,80 | 110,1 | 7059,9 | 11010,3 |
| 01/06/2012 | 2618755 | 0,16 | 1,62 | 2,37 | 228,5 | 1663639 | 859870 | 143,20 | 3,68 | 107,1 | 7086,9 | 10997,4 |
| 01/07/2012 | 2647752 | 0,16 | 1,53 | 2,04 | 228,5 | 1657285 | 856288 | 144,31 | 3,55 | 109,8 | 7096,9 | 11034,9 |
| 01/08/2012 | 2650750 | 0,13 | 1,68 | 2,10 | 229,8 | 1644927 | 855109 | 144,73 | 3,60 | 111,6 | 7121,2 | 11054,9 |
| 01/09/2012 | 2594909 | 0,14 | 1,72 | 1,86 | 231,0 | 1648554 | 845294 | 144,39 | 3,50 | 114,6 | 7149,0 | 11131,0 |
| 01/10/2012 | 2611775 | 0,16 | 1,75 | 2,09 | 231,7 | 1651525 | 847070 | 144,00 | 3,38 | 106,5 | 7163,0 | 11144,7 |
| 01/11/2012 | 2646809 | 0,16 | 1,65 | 2,19 | 231,3 | 1651314 | 873426 | 144,00 | 3,35 | 116,7 | 7195,6 | 11161,7 |
| 01/12/2012 | 2675945 | 0,16 | 1,72 | 2,16 | 231,3 | 1657545 | 907344 | 143,91 | 3,35 | 118,8 | 7213,6 | 11186,5 |

| Date | Monetary base | Fed Funds Rate | 10-year US Treasury yield | 30-year MBS yield | CPI (inflation) | Treasuries at Fed | MBS held by Fed | Home Price Index | Mortgage Rate | New Homes Sold | Total Credit | Consumption |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01/01/2013 | 2741743 | 0,14 | 1,91 | 2,54 | 231,6 | 1687612 | 931892 | 144,35 | 3,41 | 131,5 | 7255,8 | 11225,4 |
| 01/02/2013 | 2845251 | 0,15 | 1,98 | 2,41 | 233,0 | 1732915 | 991444 | 145,19 | 3,53 | 130,7 | 7270,2 | 11283,0 |
| 01/03/2013 | 2935036 | 0,14 | 1,96 | 2,49 | 232,3 | 1777715 | 1044558 | 147,99 | 3,57 | 133,6 | 7271,8 | 11261,6 |
| 01/04/2013 | 3011737 | 0,15 | 1,76 | 2,22 | 231,9 | 1820348 | 1084777 | 151,02 | 3,45 | 134,2 | 7292,8 | 11253,9 |
| 01/05/2013 | 3116932 | 0,11 | 1,93 | 2,95 | 231,9 | 1865508 | 1141675 | 153,92 | 3,54 | 128,0 | 7297,8 | 11279,5 |
| 01/06/2013 | 3201472 | 0,09 | 2,30 | 3,28 | 232,4 | 1912803 | 1175978 | 156,49 | 4,07 | 137,8 | 7307,6 | 11320,2 |
| 01/07/2013 | 3290898 | 0,09 | 2,58 | 3,35 | 232,7 | 1961858 | 1214734 | 158,35 | 4,37 | 111,9 | 7316,4 | 11343,1 |
| 01/08/2013 | 3398930 | 0,08 | 2,74 | 3,49 | 233,2 | 2007562 | 1263672 | 159,46 | 4,46 | 113,1 | 7311,5 | 11370,2 |
| 01/09/2013 | 3486920 | 0,08 | 2,81 | 3,22 | 233,6 | 2047109 | 1303434 | 159,74 | 4,49 | 118,8 | 7332,8 | 11423,9 |
| 01/10/2013 | 3589515 | 0,09 | 2,62 | 3,09 | 233,8 | 2096585 | 1353511 | 159,63 | 4,19 | 132,1 | 7356,9 | 11465,2 |
| 01/11/2013 | 3684563 | 0,08 | 2,72 | 3,29 | 234,2 | 2144303 | 1405652 | 159,44 | 4,26 | 132,7 | 7372,9 | 11542,0 |
| 01/12/2013 | 3717450 | 0,09 | 2,90 | 3,47 | 234,8 | 2190407 | 1456395 | 159,36 | 4,46 | 131,3 | 7377,1 | 11566,0 |
| 01/01/2014 | 3728483 | 0,07 | 2,86 | 3,30 | 235,4 | 2223452 | 1500619 | 159,46 | 4,43 | 133,0 | 7405,9 | 11562,2 |
| 01/02/2014 | 3833354 | 0,07 | 2,71 | 3,17 | 235,6 | 2265050 | 1534041 | 159,96 | 4,30 | 125,9 | 7463,8 | 11631,4 |
| 01/03/2014 | 3885877 | 0,08 | 2,72 | 3,23 | 235,9 | 2300431 | 1569749 | 161,28 | 4,34 | 122,0 | 7529,5 | 11714,6 |
| 01/04/2014 | 3930681 | 0,09 | 2,71 | 3,12 | 236,5 | 2334954 | 1608986 | 163,06 | 4,34 | 119,3 | 7572,9 | 11757,1 |
| 01/05/2014 | 3911525 | 0,09 | 2,56 | 2,89 | 236,8 | 2363551 | 1639729 | 164,78 | 4,19 | 134,5 | 7622,9 | 11790,1 |
| 01/06/2014 | 3948691 | 0,10 | 2,60 | 2,87 | 237,0 | 2388109 | 1649946 | 166,30 | 4,16 | 123,8 | 7670,0 | 11854,4 |
| 01/07/2014 | 3989084 | 0,09 | 2,54 | 2,87 | 237,3 | 2411465 | 1667412 | 167,22 | 4,13 | 119,6 | 7725,1 | 11878,5 |
| 01/08/2014 | 4075039 | 0,09 | 2,42 | 2,79 | 237,2 | 2429385 | 1680391 | 167,53 | 4,12 | 133,6 | 7772,5 | 11965,9 |
| 01/09/2014 | 4049189 | 0,09 | 2,53 | 2,86 | 237,5 | 2443205 | 1679213 | 167,33 | 4,16 | 138,7 | 7796,2 | 11978,6 |
| 01/10/2014 | 4001451 | 0,09 | 2,30 | 2,61 | 237,7 | 2456463 | 1699907 | 167,00 | 4,04 | 141,1 | 7830,1 | 12049,5 |
| 01/11/2014 | 3830424 | 0,09 | 2,33 | 2,59 | 237,3 | 2461613 | 1716520 | 166,75 | 4,00 | 132,7 | 7885,9 | 12095,7 |
| 01/12/2014 | 3934455 | 0,12 | 2,21 | 2,49 | 236,5 | 2461493 | 1731074 | 166,56 | 3,86 | 146,4 | 7924,6 | 12082,4 |

| Date | Monetary base | Fed Funds Rate | 10-year US Treasury yield | 30-year MBS yield | CPI (inflation) | Treasuries at Fed | MBS held by Fed | Home Price Index | Mortgage Rate | New Homes Sold | Total Credit | Consumption |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01/01/2015 | 4017103 | 0,11 | 1,88 | 2,33 | 235,0 | 2461014 | 1740752 | 166,35 | 3,71 | 156,0 | 7997,4 | 12056,3 |
| 01/02/2015 | 3840464 | 0,11 | 1,98 | 2,33 | 235,4 | 2460409 | 1743663 | 166,75 | 3,71 | 163,4 | 8037,6 | 12087,5 |
| 01/03/2015 | 4030632 | 0,11 | 2,04 | 2,40 | 235,9 | 2459847 | 1742428 | 168,21 | 3,77 | 145,8 | 8112,7 | 12152,9 |
| 01/04/2015 | 4059374 | 0,12 | 1,94 | 2,23 | 236,2 | 2459806 | 1735420 | 170,10 | 3,67 | 148,8 | 8183,4 | 12181,0 |
| 01/05/2015 | 3949372 | 0,12 | 2,20 | 2,45 | 236,9 | 2460410 | 1727303 | 171,99 | 3,84 | 150,9 | 8213,9 | 12257,7 |
| 01/06/2015 | 3919649 | 0,13 | 2,36 | 2,69 | 237,4 | 2460830 | 1729722 | 173,60 | 3,98 | 140,5 | 8249,1 | 12281,8 |
| 01/07/2015 | 3961217 | 0,13 | 2,32 | 2,76 | 237,7 | 2461238 | 1737848 | 174,66 | 4,05 | 148,2 | 8321,3 | 12327,9 |
| 01/08/2015 | 3984019 | 0,14 | 2,17 | 2,64 | 237,7 | 2461740 | 1740741 | 175,11 | 3,91 | 150,3 | 8355,4 | 12355,6 |
| 01/09/2015 | 4028486 | 0,14 | 2,17 | 2,62 | 237,5 | 2461944 | 1738592 | 175,23 | 3,89 | 136,0 | 8395,1 | 12387,2 |
| 01/10/2015 | 4060469 | 0,12 | 2,07 | 2,51 | 237,9 | 2461856 | 1745055 | 175,25 | 3,80 | 142,3 | 8453,4 | 12402,1 |
| 01/11/2015 | 4006725 | 0,12 | 2,26 | 2,68 | 238,3 | 2461696 | 1749970 | 175,36 | 3,94 | 151,2 | 8508,7 | 12442,4 |
| 01/12/2015 | 3835810 | 0,24 | 2,24 | 2,75 | 238,0 | 2461578 | 1746796 | 175,34 | 3,96 | 160,1 | 8565,6 | 12471,8 |
| 01/01/2016 | 3792723 | 0,34 | 2,09 | 2,70 | 238,1 | 2461423 | 1750129 | 175,28 | 3,87 | 156,5 | 8623,0 | 12479,1 |
| 01/02/2016 | 3872483 | 0,38 | 1,78 | 2,41 | 237,7 | 2461184 | 1749809 | 175,52 | 3,66 | 156,3 | 8683,7 | 12504,3 |
| 01/03/2016 | 3898431 | 0,36 | 1,89 | 2,44 | 237,9 | 2461239 | 1753424 | 176,84 | 3,69 | 159,8 | | |
| 01/04/2016 | 3872939 | 0,37 | 1,81 | 2,33 | 238,9 | 2461379 | 1755803 | 178,73 | 3,61 | 169,6 | | |
| 01/05/2016 | 3836501 | 0,37 | 1,81 | 2,32 | 239,4 | 2461613 | 1753848 | 180,63 | 3,60 | 168,5 | | |
| 01/06/2016 | 3825373 | 0,38 | 1,64 | 2,27 | 239,9 | 2462032 | 1746427 | 182,19 | 3,57 | 166,1 | | |
| 01/07/2016 | 3772402 | 0,39 | 1,50 | 2,06 | 239,8 | 2462596 | 1749113 | 183,43 | 3,44 | 185,1 | | |

Source: The Federal Reserve of St. Louis (2017)